VENTILATING

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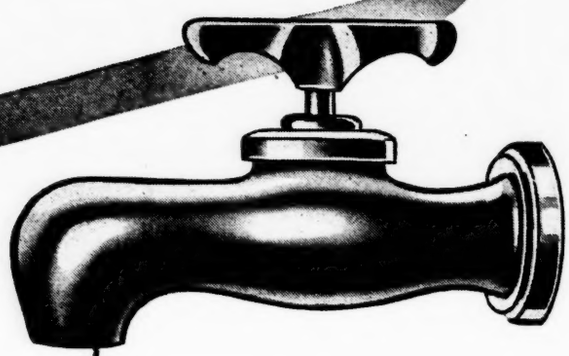
NEXT MONTH'S ISSUE

Bread is such a common-place item that few engineers look upon bread bakeries as a large market for air conditioning and refrigeration equipment. An article by Dwight Tenney will show how temperature and humidity control 13 of the 15 major steps leading up to the finished product.

WILL YOURS RUN DRY?



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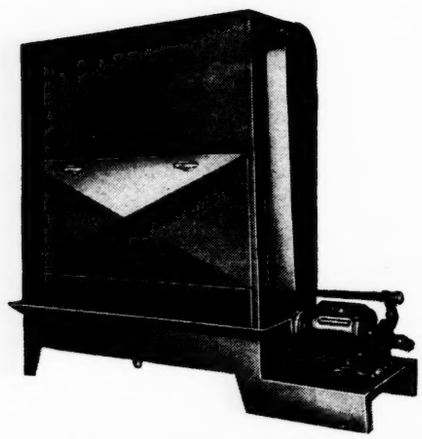

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HEATING AND VENTILATING

The Welding of Process Piping

ARTHUR N. KUGLER
Mechanical Engineer, Air Reduction Sales Co., New York, N. Y.

THE term "process piping" is commonly used to designate piping used for special purposes such as carrying fluids peculiar and necessary to some manufacturing procedure. However, the terms "process steam piping" and "process water piping" may also be employed to indicate that the steam or water is at some required temperature or pressure, separate and distinct from the normal plant lines carrying these same fluids. Thus, the classification process piping provides no clue and bears no relation to the problems involved in the fabrication and welding of such pipe systems.

In pursuing this reasoning further the logical conclusion reached is that there is no difference between process and any other piping except when the piping material differs from that generally employed, i.e., steel.

Modern industry requires a vast array of chemicals for the successful processing of many products. Some may be acid, some basic, some volatile—the range of properties encompassing virtually all chemical and physical conditions including pressure and temperature. To meet these conditions there are available literally thousands of metallic alloys; for those conditions where metals are unsuited there are available glass and even plastic pipes. Many new processes present added problems in providing satisfactory conductors for the fluids involved. In spite of the apparent complexity of the situation, the greater part of process piping installations are handled with ease employing relatively few metals and alloys.

Since the basis for this discussion must be pipe metal rather than fluid content of the line, a box chart, Fig. 1, has been prepared enumerating some of the more commonly encountered piping materials. In this and ensuing articles it is proposed to discuss the welding of these metals and alloys. No attempt can be made here to recommend any material or joining process for any particular class of service. Such data must be determined either by previous experience or special testing under required conditions.

Attention is called to the fact that if two sections are to be connected by means of filler metal of an analysis differing markedly from the base metal, a condition conducive to galvanic action or electrolysis may be created with certain types of fluid content. Therefore it is a wise precaution to submit such proposed connections to testing prior to use in service.

A study of Fig. 1 will reveal that several welding processes are indicated in each box; further, the sequence of recording these processes differs in many boxes. The sequence is roughly in the order of preference or, where preference is of no import, the listing is based on general use. Insofar as possible, reasons will be offered for preferences.

Since more than one welding process is necessary to cover the joining of the many metals represented in Fig. 1, it is necessary first to briefly review and define each one here, so that when referred to subsequently, the application may be understood. Supplementary techniques, not of general application,

will be covered under those phases with which they are connected.

Of the many types of welding currently practiced, the following six have been selected as applicable to the problems under discussion:

1. Metal Arc Welding
2. Oxyacetylene Welding
3. Braze Welding
4. Brazing
5. Carbon Arc Welding
6. Gas Shielded Arc Welding

With the exception of number 6, these processes are so well known that it will be unnecessary to illustrate typical equipment.

METAL ARC WELDING, the first process, is the common technique familiar to all. It is that arc welding process wherein the filler metal (electrode) forms one side of the electrical circuit, the other being grounded to the work. Either a-c or d-c may be used subject to the operating limitations of base metal and electrodes. In general practically all ferrous metals and alloys may be metal arc welded in all positions, i.e., flat, horizontal, vertical, and overhead (Fig. 2). While some non-ferrous metals can be arc welded in all positions, many can be welded only in the flat or horizontal positions by this technique.

OXYACETYLENE WELDING, the second process, is

When joining this → to this ↓	STEEL, WROUGHT IRON, AND GALV. IRON	COPPER AND COPPER BASE ALLOYS	STAINLESS STEELS	NICKEL AND NICKEL ALLOYS	ALUMINUM AND ALUMINUM ALLOYS	CAST IRON
STEEL, WROUGHT IRON, AND GALV. IRON	Metal arc welding Oxyacetylene welding Braze welding Brazing 1-1					
COPPER AND COPPER BASE ALLOYS	Braze welding Brazing Metal arc welding 1-2	Oxyacetylene welding Braze welding Brazing Carbon arc welding Metal arc welding 2-2				
STAINLESS STEELS	Metal arc welding Oxyacetylene welding Brazing Braze welding 1-3	Brazing Braze welding 2-3	Metal arc welding Oxyacetylene welding Brazing Gas shielded arc welding Braze welding 3-3			
NICKEL AND NICKEL ALLOYS	Brazing Metal arc welding Oxyacetylene welding Braze welding 1-4	Brazing Braze welding 2-4	Metal arc welding Oxyacetylene welding Brazing Braze welding 3-4	Metal arc welding Oxyacetylene welding Brazing Carbon arc welding Gas shielded arc welding Braze welding 4-4		
ALUMINUM AND ALUMINUM ALLOYS	Not a practical welding or brazing operation at the present time 1-5	Not a practical welding or brazing operation at the present time 2-5	Not a practical welding or brazing operation at the present time 3-5	Not a practical welding or brazing operation at the present time 4-5	Oxyacetylene welding Metal arc welding Gas shielded arc welding Brazing Carbon arc welding 5-5	
CAST IRON	Braze welding Brazing Metal arc welding 1-6	Braze welding Brazing 2-6	Brazing Braze welding 3-6	Brazing Braze welding 4-6	Not a practical welding or brazing operation at the present time 5-6	Oxyacetylene welding Metal arc welding Braze welding Brazing 6-6

Fig. 1. Methods to follow when joining one metal with another. Shaded part indicates the methods discussed in this article.

also very familiar. It derives the necessary heat and temperature from the combustion of acetylene (C_2H_2) with 99.5% commercially pure oxygen (O_2). It may be employed for welding virtually all ferrous and non-ferrous metals. Generally a welding rod of substantially the same type of analysis as the base metal is used, although with certain joint designs it is possible to secure welds without a separate filler rod. This is a parallel process to metal arc welding and, in general, may be used interchangeably with it. Welds can be made in all positions on practically all metals including the non-ferrous metals.

BRAZE WELDING, the third process, is a special application of the oxyacetylene process. The first two processes discussed involved the fusion of metals, i.e., the melting and flowing together of the component parts. In braze welding only the filler rod is melted. The strength of the braze welded joint depends upon the bonding of the filler material to the base metal, which is usually achieved by intermolecular penetration of the molten braze welding rod. The filler rod employed in this procedure is generally one of the common brasses of the basic 60% copper, 40% zinc analysis, modified to yield the desired properties.

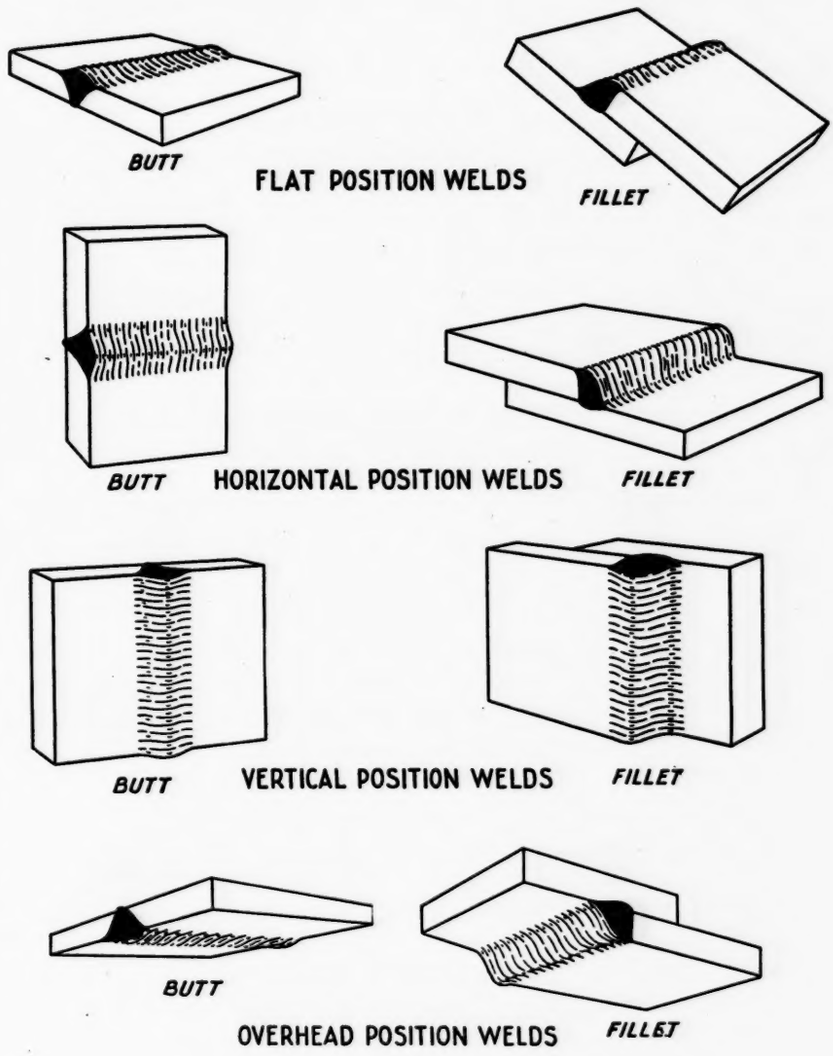


Fig. 2. Various welding positions.

In braze welding, either butt joints welded with groove welds, or lap or tee joints connected with fillet welds are employed. This fact is important as will be pointed out under the fourth process. Braze welding may be accomplished in all positions. It can be used for joining ferrous and non-ferrous metals. A flux is necessary to control the oxidation of the constituents of the filler rod and to clean the base metal ahead of the wetting or "tinning" of the brass onto the base metal. This procedure is sometimes referred to as bronze welding. However, it is the writer's opinion that the term bronze welding should be reserved for the actual fusion welding of bronze, and possibly brass, and the term braze welding should be employed in the present sense.

BRAZING, the fourth procedure, is again an adaptation of the oxyacetylene flame, although under some circumstances flames of oxygen with other fuel gases (natural gas, city gas, propane, etc.) or air with acetylene and other fuel gases may be used. Actually brazing is a joining process, the origin of which goes back into antiquity. The ancient smithies fitted all the parts tightly together after thoroughly cleaning the surfaces and applying flux. The assembly was then heated in the forge and brass spelter, usually in the form of filings or chips, was melted by the heat and run into the spaces between the pieces.

The distinguishing feature of true brazing is that it invariably employs a lap joint, into the lap area of which the brazing alloy is flowed by means of heat. Thus it will be seen that a brazed connection is stressed in shear; the welded and braze welded joints on the other hand may be stressed in tension, compression or shear.

While brass brazing, the method used years ago, still finds limited application today, newer alloys of low melting temperatures have largely supplanted this older procedure. Through research a number of alloys have been made available with melting points ranging from 1175F to about 1600F. These provide for the brazing of most ferrous and non-ferrous metals. The lowest melting point, 1175F, is possessed by an alloy of 50% silver, the balance approximately equal proportions of cadmium, copper, and zinc. This silver brazing alloy may be used for joining practically all ferrous and non-ferrous metals. Other alloys of silver-copper-phosphorus and copper and phosphorus are suitable only for copper and copper base alloys.

Special fluxes are necessary for these low temperature brazing alloys. These fluxes must be completely fluid and active at the low melting temper-

atures of these silver brazing alloys. Fluxes for welding or braze welding are not suited for this class of work. Since braze welding, the fourth process, is frequently called simply "brazing," each recommendation for the use of brazing in this discussion will include reference to the necessity of employing the lap joint, to avoid confusion.

Carbon Arc Welding, process No. 5, is another of the arc welding procedures. In this method a carbon or graphite electrode (sometimes called a pencil) is connected to the negative terminal (straight polarity) of a d-c welding generator while the positive terminal is grounded on the work. The arc created between the carbon electrode and the work melts the base metal. In some joint designs this is sufficient to make a weld; on most joints it is necessary to introduce filler metal in a manner similar to that used in oxyacetylene welding. Carbon arc welding is used principally on non-ferrous metals, and only to a very limited extent on ferrous metals. It finds extensive application in the welding of copper and copper base alloys and aluminum and aluminum base alloys. It can be used in the flat position only.

Gas Shielded Arc Welding, the sixth process, is of recent origin. Typical equipment for this procedure is illustrated in Fig. 3. Up to the present there is no record of this procedure having been applied to piping. However, it has proven particularly successful in the welding of magnesium alloys, aluminum alloys and stainless steel. Since the latter two alloys find use in process piping, this welding process is included.

Gas shielded arc welding is an arc welding procedure in which a tungsten electrode is employed to create the arc. A special holder is employed which provides a shield around the tungsten electrode. Through this shield is passed an inert gas—helium or argon. Generally d-c reverse polarity is used, although recent developments indicate some advantages for a-c, particularly with argon. Filler metal is commonly employed and is introduced into the weld in a manner similar to that used in oxyacetylene and carbon arc welding. Under some circumstances a carbon electrode may be substituted for the tungsten. Welding may be accomplished in the flat, vertical and overhead positions.

The six processes described above do not constitute all those employed in welding piping. It is believed however that they do represent the bulk of those used both in shop fabrication and field erection. The criterion used in selecting a welding process as being suitable for pipe welding has been its ability to be applied to the welding of pipe in all positions. Processes of limited application are listed for the benefit of those who may have work involving shop fabrication only.

At this point it seems appropriate to point out that there are two systems of designating welding positions and clear up any confusion that may exist concerning these two systems. The first system is that of merely indicating the position of the weld, substantially without reference to the shape of the parts welded. This is shown in Fig. 2. In this the axis of the weld, together with the disposition of the face of the weld, are the governing features. Note four positions are encompassed by this system. Actually the positions shown in Fig. 2 may be varied within limits and still conform to the definitions.

The second method applies only to piping and is based upon the position of the center line of the pipe. The three positions are indicated in Fig. 4. A study of these illustrations will show that the horizontal pipe rolling weld involves welding in the flat position (Fig. 2) only. Similarly the vertical pipe position weld requires welding to be performed in the horizontal (Fig. 2) position only. On the other hand, the horizontal pipe-fixed position weld includes welding in three positions, i.e., flat, vertical, and overhead (Fig. 2). These facts explain the necessity for a separate system to designate pipe welds.

Joining Ferrous Metals

In considering the problems involved in welding piping of various metals for process lines it will be necessary to refer to Fig. 1. The first box (1-1) is a logical starting point for the reason that steel is the commonest of piping metals. In connection with this phase, reference is made to a series of three articles[1] by the writer on the general subject of welded piping. Since both oxyacetylene and metal arc welding of steel piping have been covered in these articles, the present discussion will be confined to those phases not previously considered as well as the joining of steel to other compositions of piping. Joint designs and other welding engineering features were covered in the previous series of articles.

It will be noted that in box 1-1 (Fig. 1) where ferrous metal is to be joined to ferrous metal of the same group, the order of preference is stated as: Metal arc welding, oxyacetylene welding, etc. This sequence is employed for the reason that the bulk of larger diameter piping is metal arc welded while the smaller sizes are oxyacetylene welded. In actual practice all sizes may be welded by either process, the availability of equipment usually dictating the process to be employed. While it is a fact that arc welding is faster, particularly on larger sizes and heavier weights of steel pipe, it must be realized that a job involving only a small number of joints may frequently be welded at lower cost with oxyacetylene welding. Since the gases and equipment are invariably required for oxyacetylene cutting and heating, no extra equipment need be moved in for welding.

The braze welding and brazing processes are included for the reason that they find limited application under special conditions. In addition, braze welding is used extensively for joining galvanized

[1]Kugler, Arthur N.: The Welding of Piping. Heating and Ventilating May 1942, p 55; June 1942, p 51; July 1942, p 59.

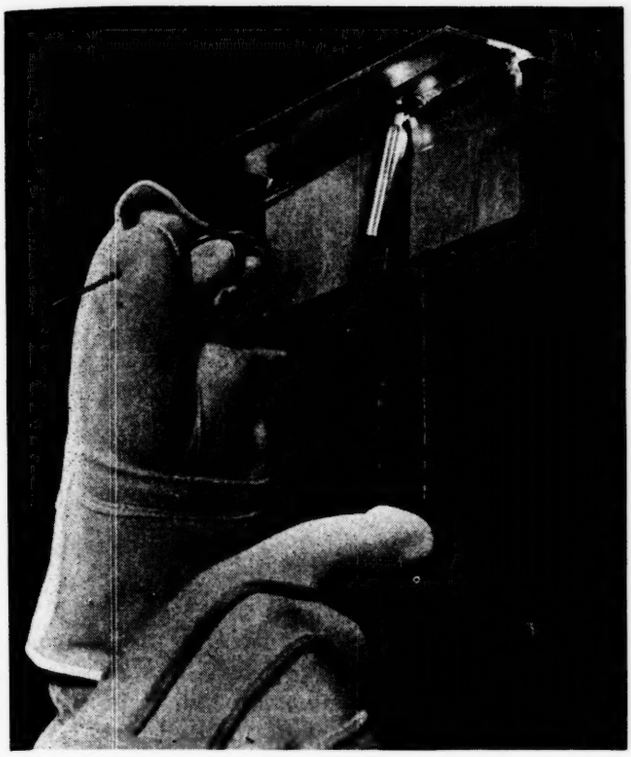


Fig. 3. The gas shielded arc being employed in the overhead position.

iron pipe.[2] In this operation it is possible to braze weld galvanized iron pipe without destroying the galvanizing, by using a liquid braze welding flux which protects the zinc.

The limitations on braze welding and brazing are, first, that they introduce dissimilar metals into the joint, brass in braze welding and a silver-copper-cadmium-zinc alloy in brazing; second, that such connections cannot be used at elevated temperatures. While no limit is placed on operating temperatures for these joints, it would be wise to limit them to services under 450-500F.

Subject to these limitations, these processes may be used for a number of applications. They offer the advantage of permitting attachments and connections to be joined with a minimum amount of heat. Such details might involve the joining of a coupling to a tank or the insertion of a small fitting for instruments, into larger piping.

Joining Steel to Copper

Progressing down Fig. 1 to box 1-2 the next grouping encountered is that of joining steel to copper and copper base alloy piping. Here, since the metals melt at such widely differing temperatures—about 2300F for steel as against 1900F for pure copper—the application of fusion welding is not possible. Therefore braze welding and brazing are listed as the preferred techniques. Metal arc welding is included for the reason that recently developed aluminum bronze electrodes have made it possible to secure a connection between dissimilar metals such as these. However, in the use of such electrodes the arc is maintained on the weld metal to avoid melting the base metal, hence the operation is more nearly comparable to braze welding.

For the braze welding of steel to copper pipes a rod of the following average analysis will give good results: (See also discussion of box 2-2.)

Analysis I

Copper	59%
Tin	0.75
Zinc	Balance

Other rods of the same basic analysis with additions of manganese, iron, silicon, etc., may be used. In this instance the limiting factor is the strength of the copper pipe, and since the above rod will meet this strength, it is adequate for the service.

A flux is essential in this operation. Such a flux should not only facilitate the braze welding, but also control the volatilization of the zinc in the rod.

Brazing of copper to steel pipes may be accomplished with the use of the silver brazing alloy containing silver, copper, cadmium, and zinc. It must be remembered that for maximum strength on silver alloy brazed joints it is necessary to employ the lap joint. Again a flux is necessary to make this type of joint.

Arc welding with an aluminum bronze electrode of the following typical analysis may offer the solution to some problems:

Analysis II

Copper	88.5 — 90.5%
Iron	0.5 — 1.0
Aluminum	9.0 — 10.0
Others	0.3 max.

This electrode is suitable for use in the flat position only, hence its application is limited.

In performing any welding on combinations of steel and copper, it must be realized that the greater heat conductivity of copper must be compensated for if a satisfactory connection is to be made. Obviously preheating of the copper member is the solution. On small units this may be accomplished with the welding torch. For larger assemblies a supplementary torch or torches may be required.

Mild Steel to Stainless Steel

The next grouping as covered by box 1-3 involves the joining of mild steel to stainless steel. Since metal arc welding is the preferred method of welding stainless steels, it is listed first. Additionally, the oxyacetylene welding, brazing and braze welding processes are listed for stainless steel.

For metal arc welding, either stainless steel or mild steel electrodes may be used, subject to such limitations as the service conditions may impose on the joints. The stainless steel electrodes would probably be the best all around filler metal to use since the deposits would be inherently stainless in character and additionally high in tensile strength and ductility.

[2]Forgett, Valmore: Brazing Galvanized Steel Pipe. Steel, July 24, 1939, 50.

Oxyacetylene welding is a process parallel to arc welding in this group, and hence the same general recommendations apply. However, since a flux is necessary for gas welding of stainless steel, fluxing will be necessary in this combination. It should be used on the stainless steel base metal and welding rods. The flux should be one specifically designed for welding stainless steel.

For brazing combinations of mild steel and stainless steel the silver-copper-cadmium-zinc brazing alloy should be used. As is common with these applications, the lap type joint is necessary to secure best strength. A silver alloy brazing flux is also essential, particularly on the stainless steel, to react with the chromium oxides.

Braze welding of these metals, while a possible operation, is not generally employed except as a means of emergency repair. A brass rod of the basic 60% copper, 40% zinc type modified by the addition of manganese or silicon is preferred; typical analyses of these rods are given herewith:

	Analysis III Manganese Bronze	Analysis IV Low Fuming Bronze
Copper	59.0%	57.5%
Zinc	Balance	Balance
Tin	1.00	0.93
Iron	1.00	1.00
Manganese	0.30	0.03
Silicon	——	0.10
Lead	——	0.10 max.

These rods are recommended for the reason that they produce higher tensile strength and better ductility than the conventional 60-40 rods. The use of flux is again important but for an additional reason in this instance. The conventional braze welding flux will be sufficient to care for the deposition of the brass rod and for tinning on the mild steel. On the stainless steel, however, difficulty may be encountered with chromium oxide. While no special fluxes for this type of work are available, either a silver brazing flux or a stainless steel welding flux should prove helpful since both of these have the necessary constituents to handle the chromium oxide.

Nickel Alloys

The methods of joining nickel and nickel alloys to mild steel are covered by the grouping in box 1-4. The specific analysis of the nickel alloys will largely determine the process employed. In view of this, the brazing process is listed first in order of preference since it is most generally applicable. Metal arc and oxyacetylene welding are used for joining the more common nickel alloys — monel, nickel, inconel — to mild steel particularly on fabrications of clad metals. Braze welding, while a possible application, is rarely used except as an emergency repair procedure.

The brazing of these metals must be accomplished with the silver-copper-cadmium-zinc alloy, melting at 1175F. A suitable brazing flux is also necessary. To secure maximum strength, it is essential that the lap type joint be used. The only limitation on silver alloy brazing would be one of high temperature conditions.

Arc welding of monel, nickel or inconel to mild steel may be accomplished with suitable electrodes.[3] For steel with monel or nickel, a monel metal arc welding electrode is recommended; for inconel with steel either an inconel or an 18-8 stainless steel electrode is suggested. In the welding of these dissimilar metals deep penetration is to be avoided, hence low currents must be employed and no puddling done.

The recommendations for oxyacetylene welding of mild steel and the nickel alloys are substantially the same as for arc welding. Monel rods are recommended for combinations of steel and monel or nickel; inconel rods for inconel and steel. Again, deep penetration is to be avoided. However there is one additional requirement to be met, namely the use of a suitable flux designed for use in the welding of the nickel alloy.

For braze welding, the manganese bronze or low fuming bronze rods may be used provided service conditions permit such a combination of dissimilar metals. A flux is again necessary to secure the best results. However, this procedure is rarely employed, silver alloy brazing being preferred.

The combination of metals as covered by box 1-5, namely aluminum and its alloys to mild steel, may be considered as practically impossible. The fact that steel melts at 2200-2770F and aluminum alloys at 815-1220F offers a partial explanation for the inability to join these metals by a welding or brazing process. It is true that experimentally a connection

(Continued on page 123)

[3]Welding Handbook—American Welding Society, 1942, pp 932-933.

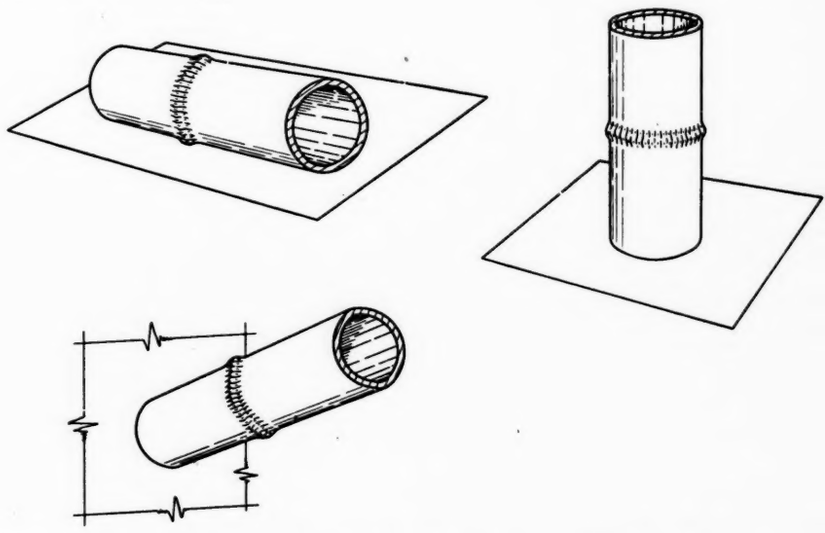


Fig. 4. Pipe welding positions. Upper left, horizontal pipe rolling weld lower left, horizontal pipe—fixed position weld; right, vertical pipe—position weld.

Foamglas insulating blocks being applied to a flat roof. The blocks also serve as a fire retardant medium.

Cellulated Glass Blocks for Insulation

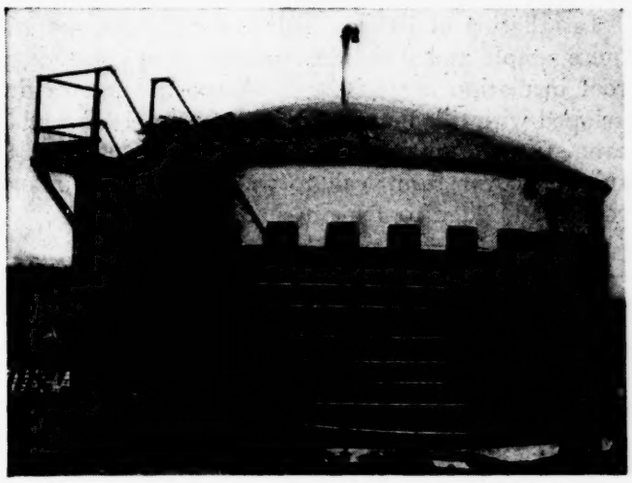
WARTIME progress of the glass industry has contributed many new and valuable products for incorporation in America's peace-time economy. One development, known commercially as PC Foamglas, has many applications for heating, ventilating, and temperature control. It is here presented as a "material for industry," the second glass product to be so introduced.

The material is of a cellular rather than porous construction, being 15 parts air and one part glass. One cubic foot contains over 5,000,000 cells of inert air hermetically sealed. This inherent characteristic, combined with other inorganic properties of pure glass, distinguishes PC Foamglas as material for insulation, vapor-sealant, and water-stopper.

Outstanding asset of the new material, particularly as relates to building construction, is its permanency. Being a true glass, it successfully repels common elements causing deterioration in other known insulating materials. PC Foamglas is impervious to water, acid atmosphere, vapor, and fumes. It is impervious to all acids except hydrofluoric and hot phosphoric acid. It is incombustible and light in weight to a point of buoyancy. For a summary of its physical properties see Table 1. It is easy to install, has a rigid and constant structure, and thus is not subject to packing, slipping, swelling, shrinking, or warping. Sufficiently strong, its compressive strength averages 150 lb per sq ft, PC Foamglas will support its own weight when used in self-supporting wall partitions.

TABLE 1.—PHYSICAL PROPERTIES OF PC FOAMGLAS

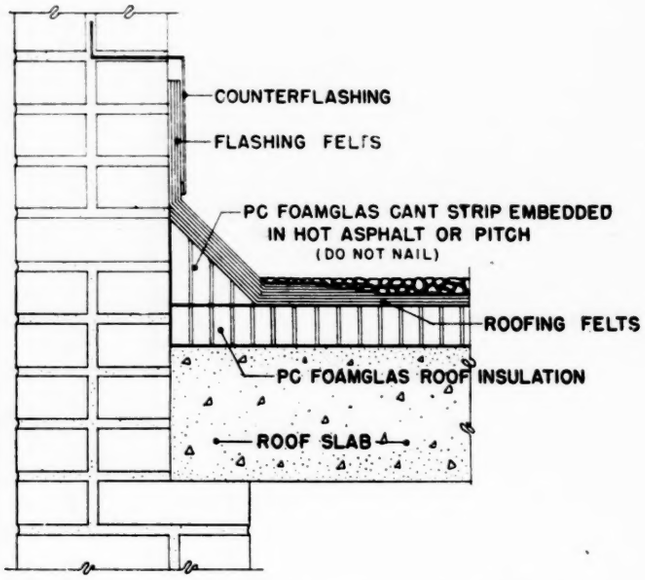
Weight	10.5 lbs. per Cu. Ft. (Average)
K (Conductivity at 50°F)	0.45 B.t.u./Hr./Sq. Ft./F./In.
K (Conductivity at 300°F)	0.70 B.t.u./Hr./Sq. Ft./F./In.
Coefficient of Expansion (F)	.0000046
Specific Heat	.16 to .19 B.t.u. per lb. per F.
Crushing Strength	150 lbs. per sq. in. (Average)
Modulus of Rupture	90 lbs. per sq. in. (Average)
Absorption (24 hour immersion in water)	Average 2% by Weight (all at surface)
Air Infiltration or Permeability	0
Volume Change with Moisture	0
Capillarity	0



Insulating blocks for this hot oil storage tank are held in place by the banding method.

A Material for Industry

It is being used in installations such as hot and cold tanks, out-door vats and oil tanks, furnaces, gas flues, ducts, and drying kilns. The blocks can


COUNTERFLASHING
FLASHING FELTS
PC FOAMGLAS CANT STRIP EMBEDDED IN HOT ASPHALT OR PITCH (DO NOT NAIL)
ROOFING FELTS
PC FOAMGLAS ROOF INSULATION
ROOF SLAB

Detail of cant strip used with counter-flashing on a roof job.

withstand temperatures up to 1000F, provided the thermal shock does not exceed 125F per hour.

Its rigid nature and light weight makes the material easy to handle and install. It can be cut and shaped on the job when necessary with such ordinary tools as a cheap saw, a roofing knife or a trowel. This facilitates application around roof or floor projections and various types of openings. The blocks cannot be nailed in place but must be used with any of the asphaltic or pitch roofing materials. Information concerning sizes and packing of this material is listed in Table 2.

Application on Roofs

Installation of PC Foamglas on flat deck roofs is quite simple and standard methods of application of roof insulation are followed. A special feature developed with this material is use of a solid triangular cant strip permitting a continuous, non-leaking insulation cover from wall to wall, eliminating many corner and edge roof maintenance troubles.

TABLE 2.—SIZES AND PACKING

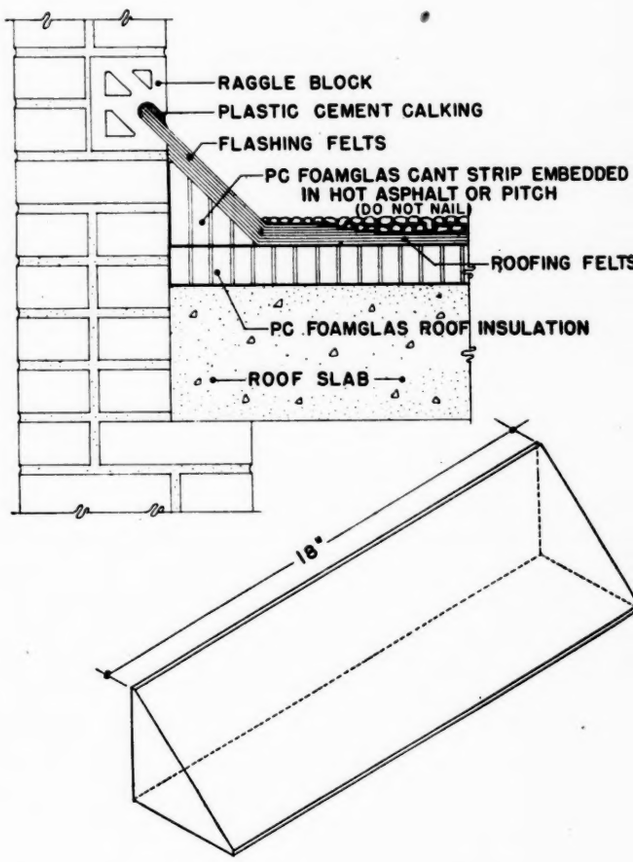
Standard Sizes	Pieces per Carton	Sq Ft per Carton	Approximate Weight per Carton, Pounds
12x18x2	12	18	38.0
12x18x3	8	12	37.5
12x18x4	6	9	37.0
12x18x4½	6	9	41.5
12x18x6	4	6	37.0

On wood decks, sheathing paper is applied first. On precast concrete or gypsum plank decks use of membrane is optional. In either instance PC Foamglas should be adhered with hot asphalt or pitch. Where hot asphalt is used, concrete or gypsum decks should be first coated with an asphalt primer. On monolithic concrete or gypsum decks, no membrane is required and steel decks should have a shop coat of paint but no membrane.

The blocks should be applied in small sections at a time, mopping only the roof area on which it can immediately be laid to insure permanency of adhesion. The finished roofing can be of any type and is laid in the usual manner in accordance with manufacturers' recommendations. For walk-on roofs no less than three plies of finished roofing should be used with PC Foamglas installations.

Use on Floors

When used in floor installations, PC Foamglas is laid in accordance with standard insulation procedure. On wood floors a layer of rosin-sized sheathing paper or unsaturated felt should be laid. On concrete floors no membrane is required. The Foamglas should be firmly imbedded in hot asphalt and a layer of 15 lb asphalt saturated felt mopped on the blocks with hot asphalt. Upon this is poured the wearing floor, in most instances concrete. For wood wearing-floors, continuous sleepers are used between

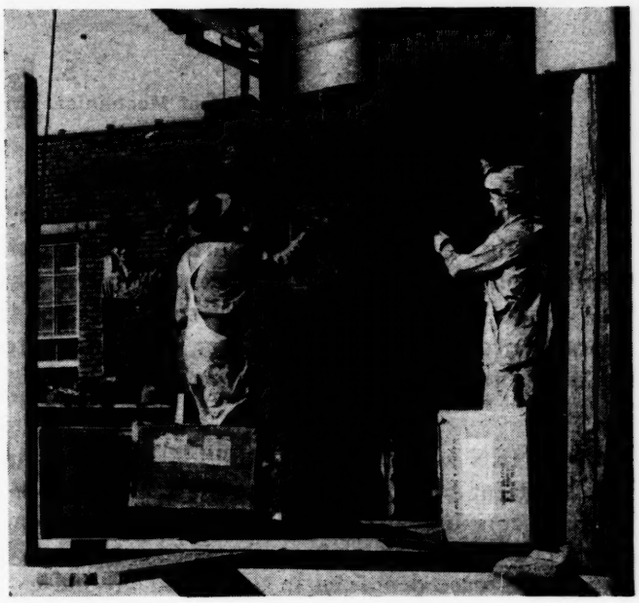


Detail of cant strip used with raggle block. Isometric shows the cant strip.

the rows of Foamglas blocks. Over this a layer of asphalt saturated felt is mopped on before the finished floor is laid. Installations completed with concrete covers show floors can withstand loads up to 2,600 lb per sq ft.

In core walls, PC Foamglas may be used in combination with all types of masonry and concrete construction, with any type tile or brick facing. In this application, where condensation may occur or where insulating material may be subject to dampness, its conductivity will not increase under such conditions. In core wall applications the material must be used with an asphaltic mortar as common plaster or cement does not give a perfect installation.

For insulating use in various types of industrial equipment, tanks, or controlled processing areas, PC Foamglas is applied by banding, wiring, or cementing according to practices in common use for other insulating materials. (See preceding page.) In some specific instances, where particular temperature control must be maintained over large areas, the insulation can be installed with use of siding materials, with layers of siding material and blocks built up in plies.



An oil extraction tower being insulated.

Drying Improves Grass Seed

Treatment severe enough to kill many kinds of seed is just what is needed to make buffalo grass seed sprout better, according to studies completed on this highly desirable grass for western ranges.

When harvested and stored over winter buffalo grass seed does not germinate well—rarely more than ten per cent, the United States Department of Agriculture has found. So a rigorous treatment has been found that has proven effective. The seed is soaked for 24 hours in a weak solution of salt peter, bagged wet and held for six weeks in cold storage—at about 40F. This is roughly equivalent of the weather the seed would ordinarily experience while snow is melting on the plains in spring. After chilling the seed must be dried for storage and planting. This treatment is called *Vernalization*—exposure to spring. After such vernalization such seed will give 50% germination, and good seed may show 80% germination.

A special seed drying apparatus has been developed by the Soil Conservation Service and the State Experiment Stations at Hays, Kans. The machine keeps the seed stirred and moving in a thin layer on belts that travel slowly through a current of warmed air. Two hours in air at from 100 to 120F will dry the seed and prepare it for machine planting. The machine will dry the seeds at a rate of 100 pounds per hour.

7,500 Factories Cooperate in Fuel Conservation

Responding to the plea of War Mobilization Director James F. Byrnes for assistance in averting a fuels shortage this winter, the National Fuel Efficiency Program of the Department of the Interior has pledged that an army of volunteer workers and 7,500 large industrial consumers of fuel throughout the nation would "cut waste to a minimum and make every pound of coal, every gallon of oil, and every cubic foot of gas do more work."

Launched more than a year ago in cooperation with the Bureau of Mines and now active in every industrial section of the United States, the National Fuel Efficiency Program already has saved large quantities of fuel by eliminating waste and improving insulation and combustion efficiency of heating and power plants in commercial and industrial buildings, both large and small.

Owners and managers of office and apartment buildings, factories, plants, theaters, churches, bakeries, and other commercial users of fuel have signified their willingness to cooperate in the program started by the government by signing pledges to track down and eliminate waste and inefficiency in the generation of energy.

Test of Dust Filter Used as Grease Trap

S. F. DUNCAN
Associate Professor of Mechanical Engineering, University of Southern California

Use of air filters as grease traps is quite common in buildings (and on shipboard) in connection with ventilation for kitchens. However, there have been few data available on this subject, so that this report prepared for a filter manufacturer is of especial interest.

KITCHEN ventilation, in addition to providing sufficient fresh air to maintain reasonable comfort, presents the problem of grease removal from the discharged air to prevent the nuisance and fire hazard of grease deposited in ducts and around exhaust openings. The desirability of removing grease from the exhaust air is obvious and various means are now in use. Usually the device used is one of the numerous types of ventilating air filters designed primarily to collect dust. Characteristics of dust filters are readily tested by means already familiar to the users and manufacturers but no extensive work has been done on laboratory determinations of the performance of dust filters as grease traps.

An examination of available data on cooking temperatures, properties of fats and oils used, and conditions existing during cooking in both large and small kitchens yields data from which a laboratory test setup and procedure can be designed. As to the fats used, it appears that organic materials such as cotton seed oil, lard and corn oil, have flash points varying from 480F to 580F, while bakery cooking practice uses a top deep frying temperature of 390F. Observation of kitchens shows that there is smoke and spatter attendant on practically all frying operations and it must be concluded that some of the grease is not only above its flash point but is hot enough to be decomposed, leaving the familiar black tarry residue on hot surfaces.

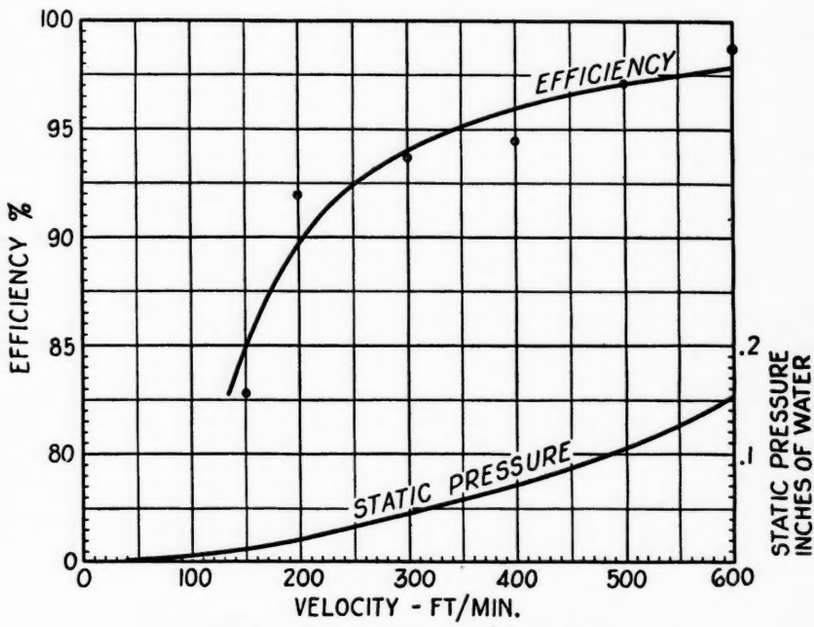
The source of the air-borne grease that collects so obviously in kitchen exhaust systems can possibly come from smoke, evaporation, and spattered droplets. The performance of a grease trap will be measured by its ability to catch and hold a large percentage of the grease passing to it from these three sources. An ideal laboratory test would evaluate grease trap performance for each of the above mentioned types of grease dissipation provided tests showed this refinement to be necessary.

A further analysis of the source of air-borne grease has led the author to conclude that, of the three possible sources, spatter accounts for most of the grease in the exhaust air. The bases for this conclusion are observations of hot grease behavior. It is well known that grease will spatter several feet when, for instance, a batch of French fries is dropped in the deep grease or a steak is put in a hot pan. The cause of this spatter is attributed to sudden vaporization of food moisture. Some smoke will also arise from these and similar operations but the source of smoke is from marginal areas where the grease layer on hot surface is thin. White paper held near the cooking operations shows fine droplets of melted grease impinging on the paper. Evidence of vapor condensing on cold surfaces is not readily obtained.

Consideration of the foregoing indicates that two tests should suffice, one being run on smoke alone and the other on non-smoking hot grease artificially spattered. The test equipment should be designed to collect all grease except that passing through the filter. Smoke tests should be run on smoke alone.

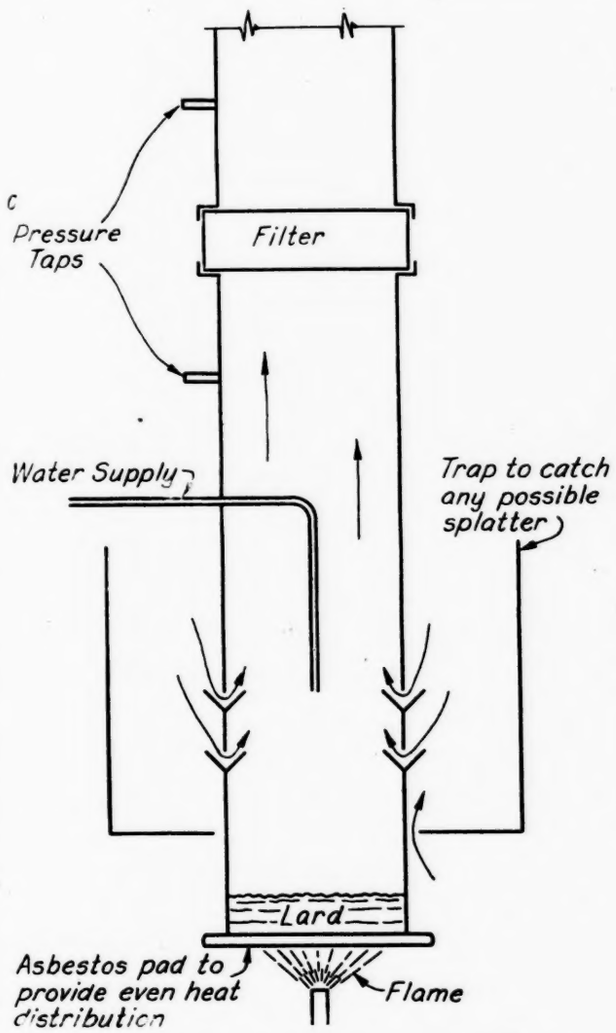
Making the Smoke Test

The smoke tests were run first. A pan of lard was set on a gas burner and the heat adjusted to



Air Filter Performance as Grease Filter

produce copious smoke without detectable spatter. The smoke was drawn through a standard 20 in. x 20 in. filter, the filter being dry and the weight taken carefully before and after each run. The smoke was observed to pass through the filter and on through



Arrangement for Making Grease Filter Test

the exhaust fan. The air velocity at the face of the filter was 350 fpm. At no time during or after the smoke test was any grease detectable on the duct walls or on the filter. Since the filter did not gain weight and since the temperature at the filter was held at 70 to 80F it appears that the possibility of vaporized grease being present in the kitchen exhaust is small and that the principal cause of the grease nuisance is from spattered droplets. Accordingly the spatter test was devised and run.

The test duct was set up as shown in the accompanying sketch. The temperature of the lard was kept just below the smoking point. Water was dripped in at a rate sufficient to keep the grease spattering. Louvers were so placed to prevent grease getting outside of the duct. Around the duct was placed a trap to collect the occasional drops that got through the louvers. Every part of the assembly was so arranged as to be readily disassembled so that each part could be weighed on a sensitive balance (sensitivity, .05 grams). Air flow was measured on the discharge side of the apparatus using a calibrated square edged orifice plate.

Tests were conducted at 150, 200, 300, 400, 500, and 600 fpm velocity.

At the beginning of each test all parts were weighed and 150 grams of lard were placed in the pan. Then the parts were assembled and heat was applied to the pan raising the temperature of the lard to a point below the smoking temperature. Water was dripped into the hot grease at a rate to keep the grease spattering. Air was drawn over the pan and through the filter at the desired velocity for the particular test.

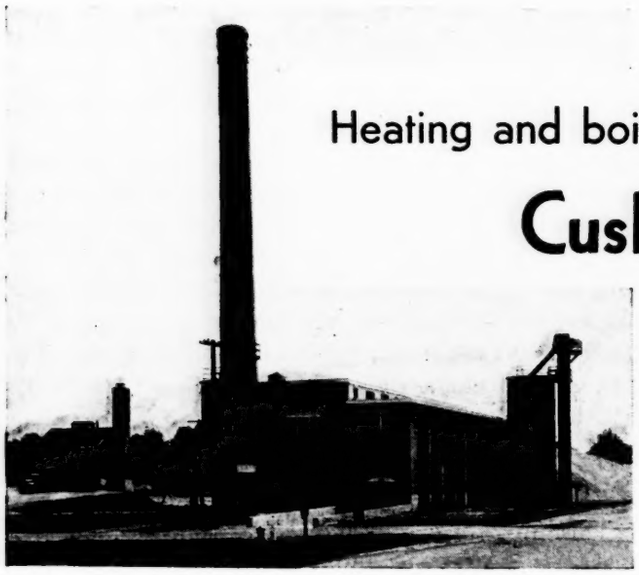
Each Test Ran for One Hour

This procedure was allowed to run one hour for each test. After the test had run an hour the set was disassembled and each part carefully heated to drive off any moisture that might have been trapped on the walls of the ducts ahead of the filter or left in the pan. Then each part was weighed. The amount of grease fed to the filter was determined by loss in weight of the pan subtracting the increase in weight of the duct and trap around the duct. The filter was weighed and the amount of pick up on the filter was determined. The difference in weight between the net loss in grease from the pan and the increase in filter weight was assumed to have passed through the filter. The filter efficiency was then determined by dividing the increase in filter weight by the net loss of weight from the pan.

Efficiency Increased With Air Velocity

In conducting the test as above outlined at the different velocities, the filter which was 7 x 7 x 2 in. (Farr type 44) collected from 40 to 75 grams. The low value was at the lowest velocity and the high value at the highest velocity. The results are as shown on the accompanying graph with the plotted points shown. The point shown at each velocity was selected as the most accurate of a series of tests. All tests showed an increasing efficiency with increasing velocity corresponding to results using dust in place of grease.

In consideration of the foregoing it appears that the grease from cooking which is collected by filters or on the ducts and fan equipment when no filters are used is in the form of small liquid droplets and not a vapor. The test results demonstrate that the grease is collected by impingement and that to obtain a reasonable efficiency of removal, a velocity high enough to cause sufficient air turbulence is necessary. It was noted that the smoke that is caused in cooking by the spattering of grease on hot surfaces does not condense under normal conditions and that the exhausting of such smoke does not make a hazardous condition in the ventilating system.



Exterior of the boiler house. Coal supply silo is at the right, and the ash disposal silo in front. Incinerator building at left.

Heating and boiler plant facilities at the

Cushing General Hospital

F. N. HOLLINGSWORTH

ONE of the most recent additions to the United States Army Medical Department's facilities in this country is the new Cushing General Hospital at Framingham, Mass. Intended to care for the sick and wounded returned from overseas battlefronts, it is outfitted with the modern surgical and medical equipment, and is staffed with medical specialists. It is also equipped to rehabilitate physically those who come under its care.

Located on a 110-acre plot just on the edge of the town, the hospital comprises over 80 all-brick buildings, most of which are interconnected by enclosed covered corridors or walkways.

The plant cost $5,000,000, and will serve as a model for other hospitals of the Army to be built or being built in other parts of the country. Medicine and engineering, through the Medical Corps and Engineering Corps of the Army, have combined with science and industry to make this one of the best of the great American workshops for the repair of human destruction caused by war.

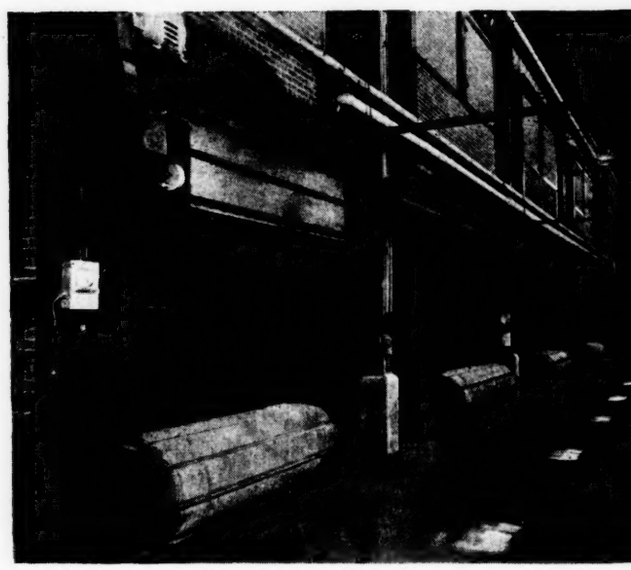
It has a normal capacity of 1750 beds, which can be increased to 2200 if necessary. In addition to medical and surgical facilities the hospital provides recreational, educational, physical reconditioning and occupational therapy. It is a neurosurgical center, as well as a headquarters for treatment of men from New England. To give an idea of the vastness of this project, it may be stated that it is a measured mile from the reception room at the main entrance to the hospital kitchen.

Included are two large mess halls for enlisted men and civilian help, one of them especially for walking wounded, an officers' mess hall, officers' club, small and large theaters, chapel, modern telephone building, army general store or Post Exchange, administration building, 12 recreation rooms, post and telegraph offices, library, 56 wards with large solariums and sun porches, 102 nurses' sitting rooms, breakfast rooms for nurses, medical laboratories, eye treatment and dental rooms, a glass covered garden where patients may work if they wish, a huge kitchen and equally large bakery, a gymnasium accommodating 3,000 persons, utility buildings and warehouses. In the surrounding grounds are parks, concrete walks and paved roads, and an athletic field. There is also a broadcast system, with music at definite periods, and many bedside phones.

All buildings but two, the administration building and the nurses' quarters, are one-story, with asphalt shingles. There are some 5,030 windows. Each ward has its own electric diet kitchen. Besides the medical staff and administrative officers, 420 enlisted men and 600 civilians are employed steadily.

Heating is from a central system, with a large brick boiler house located at a corner of the grounds, with steam piped underground to the various buildings. Exceptions are the Utility Administration Building, Maintenance Shops and Animal House, which, because of remote locations, are supplied by a low pressure system with cast iron boilers.

The main boiler plant consists of one 300 hp and three 500 hp Union Iron Works, 3-drum, low head, bent tube watertube boilers, which are designed for 160 lb steam working pressure and are capable of



Battery of 4 boilers; 3 are 500 hp and one 300 hp.

General view of the hospital showing a part of the one-story ward buildings.

operating at 200% of rating or better. They are supported from structural steel framework and enclosed heavy brick settings. Boilers are fired by traveling grate Combustion Engineering stokers, using No. 3 anthracite screenings. Stokers for the 500 hp boilers are 11 ft wide by 17½ ft long, and that for the 300 hp boiler is 7½ ft wide and 9 ft 2 in. long. Each boiler is equipped with the usual trimmings for 250 lb steam pressure, including safety valves, non-return stop valves, high and low water alarm column, chain operated quick closing water gauge and try-cocks, steam gauge, feed and blow-off valves, and soot blowers.

Each also has a motor-driven forced draft fan whose vortex inlet damper is controlled by an automatic combustion control system, designed to proportion air supply to fuel rate while maintaining a balanced draft condition in the furnace.

Individual instrument panels are provided for each boiler. Each panel has 9-point gauges, CO_2 recorders, flue gas pyrometers, and steam flow meters.

Coal may be taken directly from cars through a track hopper, reciprocating plate feeder and bucket elevator to a tile silo of 110 tons capacity. A stockpile is maintained which at this writing held some 18,000 tons. From the silo coal is fed by a screw conveyor directly to the stoker hoppers, while ashes are dumped directly from the boilers to a drag conveyor into a bucket elevator and stored in an elevated tile silo holding 18 tons.

Distribution of Steam and Hot Water

Steam is generated at 100 lb pressure and reduced in the boiler house to 40 lb, then distributed to the various buildings at this pressure. About 400 feet of American District Steam conduit are run underground to the principal group of buildings and then through pipe spaces under the walkways and buildings. Steam at 40 lb pressure is used for heating water, for cooking, and for sterilizing instruments. This pressure is further reduced to 5 lb for heating. Condensate, from the equipment using 40 lb steam, is passed through inverted bucket type steam traps which discharge to vented flash tanks through float traps to the inlet of one of thirteen duplex vacuum pumps. Each pump unit serves a group of buildings closely related as to location and distance from each other. The discharge main from these pumps follows the general run of the supply main back to the elevated 1500-gallon surge tank in the boiler room, and from this tank flows through an open feedwater heater to the two duplex piston boiler feed pumps. The main then goes to the boilers through automatic water feeders. The feedwater heater is supplied with exhaust steam from the boiler feed pumps and this is supplemented with live steam through a pressure reducing valve.

Every building, and each separate ward, has its own hot water tank ranging in capacity from 60 to 500 gallons. Most of the buildings are heated by means of American Radiator thin-tube radiators. Auditorium type units supply heated air for the larger spaces and McQuayle units are installed in many of the corridors or covered walkways. Railroad sidings are provided for hospital trains. Heat may be maintained in the trains at the siding from underground steam mains.

Engineers figure that the steam load for the winter will total 200,000 lb per hour. Feedwater consists of 10% Framingham town water from driven wells, and the balance is return, or condensate. Feed water is treated with Hagan phosphate and tannin, and the chemical characteristics are checked daily.

While most of the ventilation is natural cross ventilation, it is planned to use unit air conditioning for the operating and recovery rooms—possibly one or two others as experience proves necessary. Wards are long and narrow, with wide aisles and two rows of beds in partitioned sections along either side. Thus it is easy to provide plenty of fresh air from the many windows. The kitchen and bakery also have natural ventilation, but in the kitchen square hoods over the ovens and steam kettles exhaust excess heat and odors through the roof.

ENGINEERING CREDITS

Engineers, U. S. Army Engineer Corps.
General contractor, Turner Construction Co.
Heating and plumbing, C. H. Cronin, Inc.
Insulation, Hinman Asbestos Co.
Commanding Officer, Col. George D. Chunn.

Isometric Drawings for Pipe and Duct Work

In which engineers relate their experiences and express opinions regarding the use of isometric drawings in preference to the conventional system of representation.

CONSIDERABLE training and experience are required to assemble the information found on a conventional orthographic drawing, and from the three or more views to form a mental picture of the object illustrated. An isometric drawing makes it possible to obtain the sense of length, breadth and depth at one glance.

However, while isometrics are easier to understand, and of value when used by persons not too well grounded in interpreting orthographic representation, the draftsman must know how to make such drawings.

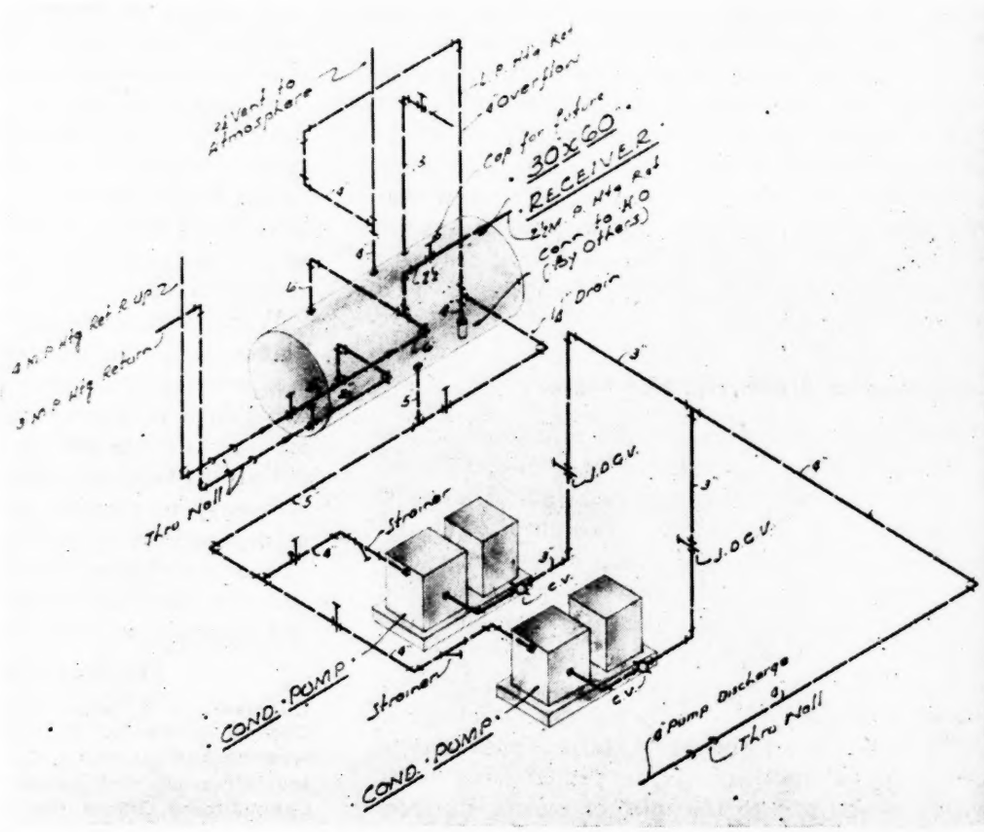
In order to learn how extensively isometric drawings are being used in this industry, and what the results have been, HEATING AND VENTILATING collected reports of the experiences of a number of engineers with this type of illustration. The replies received follow:

Harold Varellas, Specification Engineer, Penn Electric Switch Co., Goshen, Ind.: During the recent shortage of experienced workers both in the production and engineering division, we have used isometric drawings quite extensively to convey better the piece part or assembly of our various devices to the inexperienced production men and women who are unable to interpret the conventional and commonly used orthographic drawing.

In the area around Goshen, we have had quite a number of the tuition free government sponsored courses in various subjects including "Industrial Production Illustration," which had our own commercial artist as instructor. We were able to pick up a couple of fellows from this group of students and now have a staff of men who are quite adept at both orthographic and isometric drawings. With the help of free hand sketching joined with straight isometric drawings, we have found it takes much less time to produce a single view isometric which shows to better advantage the part or parts in question, than it does to make a three-view orthographic drawing which is hard to understand in production. In this way, we figure we save time and money at both ends.

As to the reactions from the field and from production, they have all been very favorable and, in general, they are calling for more of this type of drawing to supersede the conventional orthographic drawings.

A. G. Sutcliffe, Chief Engineer, Ilg Electric Ventilating Co., Chicago, Ill.: We have noticed a definite trend toward isometric drawings, and we



Isometric diagram of piping connections in a pump room. It is used with a plan drawn to scale.

have been making a few isometric drawings for some of our engineering and development work. We believe that the isometrics are definitely good on piping and duct systems.

As a rule, we find the draftsmen are not very well accustomed to isometric drawings, and know practically nothing about mechanically drawn perspectives. To this extent, the drawings are slightly more expensive. But it is my opinion that this condition will not hold after the men become accustomed to the work.

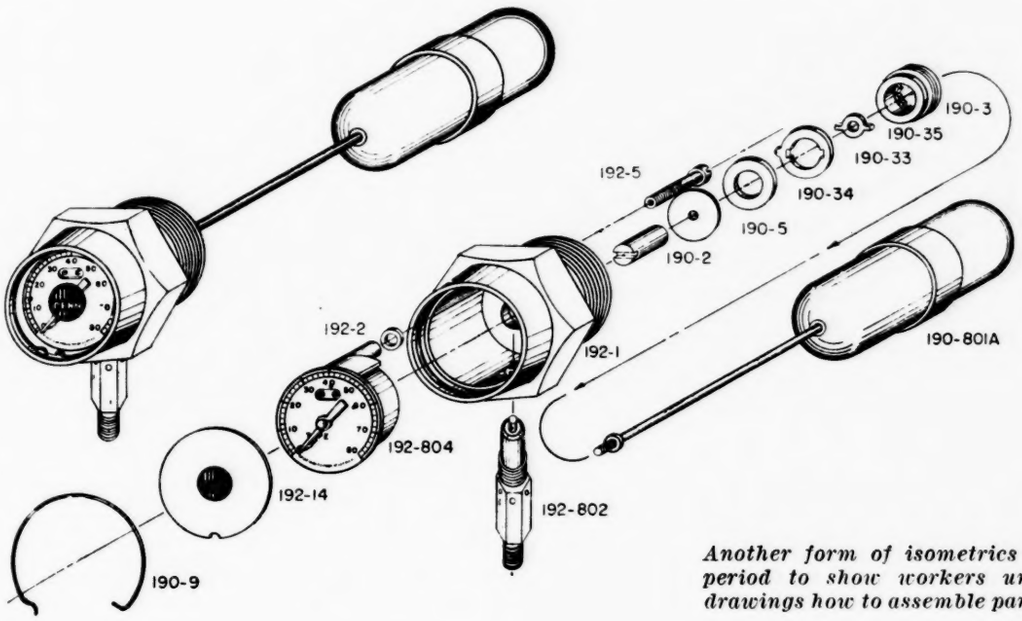
W. E. S. Smith, Designer and Construction Superintendent, Crane Co., Chicago, Ill.: We have found the use of perspective of great value in conveying information to laymen who would otherwise have difficulty in interpreting sketches and drawings presented in the regular way.

However, it requires the services of a draftsman especially trained in this type of work and such men are not readily available. Furthermore, they take more of the draftsman's time than the regular drawing methods. He frequently has to lay out the work in the regular way first, and then project his points accordingly. This is particularly evident in 2-point or 3-point perspectives but not so much so in isometric drawings.

Therefore, with us it is the exception rather than the rule that we use perspectives. We do use them, however, to supplement the regular orthographic projections. They are much easier for the average person to understand and to follow the continuity of the thoughts expressed and represented by the drawing. We regard this method of projection as having very definite value within the scope of its limitations.

Eadie, Freund and Campbell, Consulting Engineers, New York, N. Y.: For many years we have used isometric single line diagrams to supplement conventional plans, elevations and sections wherever intricate piping connections to apparatus are involved. Such isometric diagrams serve as an aid to bidders and also to the mechanics in the field.

It is our opinion that any good draftsman can prepare such isometric diagrams. Undoubtedly they involve additional drafting time because, as we stated, they are in addition to plans and sectional views which we would prepare in any event. We have kept no records of additional time involved in the preparation of such isometric diagrams.



Another form of isometrics developed during this war period to show workers unable to read orthographic drawings how to assemble parts to form some specific unit.

C. A. Thinn, Manager of Service, C. A. Dunham Co., Chicago, Ill.: We have used isometric drawings a great deal in our advertising, as you will note from the Dunham Handbook No. 514.

However, in our shop we are using the more conventional method of preparing mechanical drawings for shop use.

There is one drawback to isometric drawings and that is that it takes an expert to make a drawing that is really acceptable. Furthermore, the making of an isometric is slow as compared with the regular three dimensional drawing. However, if properly understood, it can be used to great advantage.

R. A. Klingeman, Charles T. Main, Inc., Engineers, Boston, Mass.: In our work as engineers and architects we frequently make use of an isometric drawing to present some intricate portion of piping and duct work and other construction.

We also make use of perspective drawings in connection with architectural problems.

In the field or shop an isometric drawing, if well presented, very likely is a help to a workman not familiar with reading plans.

S. L. Fishman, Public Service Co. of N. Ill., Blue Island, Ill.: When gas fired warm air conditioning first became popular there was a strong tendency by all engaged in the business to make layouts for

each and every job—manufacturers, installers and others directly interested. As time went on and experience and training were acquired as a stock in trade, there was a tendency to eliminate any drawing layout work. This applies particularly to residential heating which is our chief concern here. This situation led to many unsatisfactory jobs that needed major corrections shortly after they were installed.

A good layout for an average 6-room residence costs at least $25. Many builders refused to pay this and preferred to let the job to the lowest bidder, regardless of decent standard equipment and installation. We believe it is false economy as many careless and troublesome jobs resulted to plague us who have been left to assist in maintenance and operation of these units.

I agree that a good isometric drawing can be made clearly and concisely for most smaller jobs. We do not do any direct drafting for customers, generally referring them to heating contractors, engineers and architects when necessary. On our own jobs, where trouble is encountered, or on details where trouble may occur, we make detailed phantom isometrics to show special connections and sectional views. Most tradesmen can follow a picture better than a blueprint as building construction is so variable that a standard blueprint is most generally valueless.

R. W. Grott, Department of Purchasing and Engineering, J. O. Ross Engineering Corp., New York, N. Y.: We have not found it necessary to use isometric drawings. We are still using the conventional 3-view mechanical drawings. We have found in general, however, that the average draftsman is not entirely familiar with isometrics. We occasionally make a drawing in this manner, and have found this to be the case. So off-hand I should say that to change over from the conventional method to isometrics would take considerable time and during the transition period it would be more costly. After the draftsmen are familiar with it, I can't see why this system should cost any more than the conventional one.

As for the difficulty in securing draftsmen, we have found it far from easy all through the war years to find any kind of draftsman, as you probably know.

Henry A. Green, Jr., Roslindale, Mass.: Isometric drawings are not warranted either economically or practically. In duct design I almost never use them. In piping design, isometrics are only necessary when there exists an exceptional number of small piping connections to one piece of equipment or to a few pieces of adjacent equipment.

For piping and duct work design for distribution, I find that a plan with sizes, horizontal dimensions and grades to determine avoidance of structural and other interference suffices when a ¼ in. scale is used for plan, elevations and section to clarify equipment and equipment connections.

Undoubtedly it would be difficult to hire draftsmen with the ability to make isometric drawings. Economy also enters into the conversion of experienced draftsmen.

R. D. MacMahon, General Supervisor, Commercial Sales, Southern California Gas Co., Los Angeles, Calif.: During the war period, we were not called upon to make any layouts. It is our reaction, however, that drawings of this type would be very advantageous.

Charles Foster, Consulting Engineer, Duluth, Minn.: I use a form of isometric drawing quite extensively. I have used this type of drawing for a good many years and find that it is very helpful to the average mechanic as he is able to visualize what we are trying to do more clearly than with ordinary drawings.

F. J. Bassett, Manager, Taunton Gas Light Co., Taunton, Mass.: We use this system of drawing very rarely. General layouts for our own work are standard plan and elevations. When we make layouts for customers, we may include a perspective drawing.

We are operating at present without a full-time draftsman and we have four or five others who have been doing drawings when necessary on a part-time basis. We have no difficulty in making up isometric drawings when needed.

Superintendent, a Western Power Company: Fortunately, we have not as yet been required to resort to this method of illustration. Personally, I believe the cost will be substantially greater and there is likely to be difficulty in obtaining draftsmen familiar with this type of work.

W. G. Rundell, Air Conditioning and Commercial Refrigeration Divisions, General Electric Co., Bloomfield, N. J.: In general it may be said that it is not standard practice for the Air Conditioning and Refrigeration Divisions to use isometric drawings. We do make use of this method of delineation as we have in the past for certain special applications, but regular orthographic projection remains our standard means of conveying information from the designer to the shop.

Mechanical Engineer, Department of Water Supply, Western City: We use isometric drawings when it is necessary to clearly show arrangement and details of piping, duct work, etc.

We have a few draftsmen who are familiar with this type of work and therefore have not tried to train or secure others having these qualifications.

In our work we have used isometric drawings only to show general arrangements and to aid in understanding the conventional three-view detail drawing. Because of this, cost comparisons have not been made.

A. G. Vosburgh, Product Engineer, American Air Filter Co., Louisville, Ky.: We are not using isometric drawings at the present time nor do we see any need for using them in the near future. It would seem to me that it would be just as hard to find artists to make isometric drawings as it is now to obtain mechanical draftsmen.

Atmospheric Pollution Due to Gas

ARTHUR C. STERN

Flue gas is the principal source of gaseous air pollution in cities. A discussion of these contaminants, and abatement action for one follows. For data on stack influence see Part 1, in the January issue.

Part 2

Experience has shown that the principal sources of metropolitan gaseous air pollution are the large number of stacks and exhaust pipes discharging products of the combustion of fuels. The principal component of flue gas is carbon dioxide and, as a result, analyses of city air show maximum concentrations of CO_2 of the order of 0.04% as compared with 0.03% in rural air. An increase of this order of magnitude has no known deleterious or objectionable effect upon either plant, animal or human life; materials or structures.

Combustion processes producing CO_2 almost invariably yield carbon monoxide when combustion is imperfect. Since imperfect combustion is the rule rather than the exception, CO is to be found in the stack or exhaust of almost every fuel burning device. The percent of CO in almost all exhaust gases is appreciably smaller than the percent of CO_2, so that the quantity of CO emitted to the atmosphere will, in any area, be less than the CO_2 emitted unless some specific high CO source is present, such as a blast furnace or cupola. The CO/CO_2 ratio for gasoline engines varies from 1.0 at an air-fuel ratio of 11 lb per lb to 0.1 at an air-fuel ratio of 14 lb per lb, and averages about 0.4 at the carburetor setting usually found in automobiles. In contrast to this furnaces and diesel engines usually operate at CO/CO_2 ratios closer to 0.01.

Pollution From Automobiles

We may therefore assume that the worst atmospheric pollution by CO will occur in areas of greatest automotive traffic density and that if CO concentrations in these areas are not deleterious to the health, they will not be so elsewhere in the general atmosphere of the community. This is particularly true since CO concentrations such as exist in even highly polluted atmospheres are not known to adversely effect either plant life, materials, or structures.

Studies made in areas of greatest traffic density and greatest outdoor exposure to automobile exhaust gases have failed to show that even traffic policemen are harmed by their carbon monoxide exposure. Recent studies[6] in New York City have shown average CO concentrations in city air at locations of little or no automotive traffic to be only 6 ppm. In locations of much traffic, the average was 32 ppm and the average of maximum concentrations registered was 68 ppm. These are ground level concentrations, which, according to this study, are 3 or 4 times higher than those 30 or 40 feet up in the air. These same studies also included the problem of disseminating from shore ventilating buildings the large quantity of CO accumulated by an underwater vehicular tunnel, in this case the Holland Tunnel. It was shown that even when over 200,000 cfm of air containing 200 ppm of CO were discharged, the atmospheric concentration at stack height level 40 feet downwind from the stack was only 20 ppm. When it is remembered that (a) carbon monoxide is not a cumulative poison and (b) that exposure to even 100 ppm for an 8-hour day will be too little to produce objectionable subjective symptoms, it will be seen that there is no present evidence condemning CO as an atmospheric hazard.

The other non-acid gases discharged in flue gas or exhaust gas from the combustion of fuel are in too small quantity to be significant as atmospheric pollutents except in their capacity as objectionable odor producers. Oxides of nitrogen in exhaust and flue gases, althought forming a major criterion limiting the use of diesel engines in confined spaces, are present in very small quantity in the flue gases from combustion processes. They hydrolize to form nitric and nitrous acids in air but their contribution to atmospheric acidity is small.

Sulfur Dioxide

Although concentrations of SO_2 in air over 1 ppm will unfavorably mark or kill vegetation, those below 0.2 ppm cause no known damage to plant life. The effect of concentrations between 0.2 and 1 ppm on vegetation is still somewhat controversial, although we have good reason to believe that those between 0.5 and 1 ppm adversely effect the yield of crops. Concentrations of this order of magnitude have no proven adverse effect upon health. The generally accepted maximum allowable concentration of SO_2 for human exposure is 10 ppm, which is considerably higher than any atmospheric concentration yet recorded other than in the direct wake of gases from a particular stack.

It has been conjectured that in the famous Meuse Valley disaster of 1930, in which the valley was in a

[6] Yant, W. P., Levy, E., Sayers, R. R., Brown, C. E., Traubert, C. E., Frevert, H. W., and Marshall, K. L., Carbon Monoxide and Particulate Matter in Air of Holland Tunnel and Metropolitan New York, Bureau of Mines Report of Investigations 3585, Nov. 1941.

smoky fog for four days, the atmospheric concentration may have reached close to 40 ppm.

Analyses of the air of a number of cities, Table 2, (Ref. 7), have shown that the SO_2 concentration on an average day is usually less than 0.2 ppm. However, measurements made on humid calm winter days yield concentrations considerably in excess of the annual average, with readings over 0.3 ppm being not uncommon. Quite a few of our large cities can therefore expect a number of hours each year when SO_2 concentrations are high enough, particularly when associated with a fog or a mist, to injure vegetation and cause unpleasant respiratory manifestations.

Although reported as SO_2, most atmospheric SO_2 analyses are for total volatile sulfur in the air as SO_2, H_2S, etc. In wet weather, part of this total sulfur oxidizes to SO_3, and as such is absorbed by the rain or mist to form sulfuric acid, dilute solutions of which find their way onto exposed vegetation, fabrics, buildings and structures or into our lungs. The extent to which this acid injures buildings and materials is best indicated not by experiment but by comparison of the life of similar materials in city and country environments. Based upon this evidence, we must conclude that present SO_2 levels in city air render it definitely corrosive to these substances and structures.

The extent and cost of this damage alone is usually deemed sufficient reason for limiting the SO_2 content of an urban atmosphere without venturing into the more controversial areas of health and plant pathology. Limitations of SO_2 in rural areas, where heretofore required, have been based on damage to crops and livestock. In one recent instance, such limitation was required because of damage more than 10 miles away down the Columbia River Valley, since it had been proven that, under unfavorable meteorological conditions, the valley acted as a trough carrying smelter effluent downstream in almost undiminished intensity.

TABLE 2.—ANNUAL ATMOSPHERIC SO_2 CONCENTRATION, P.P.M. IN 0-5 MILE ZONE FROM CENTER OF CITY.

City	Winter	Average Summer	Year	Winter	Maximum Summer	Year
Pittsburgh	0.093	0.060	0.078	0.897	0.828	0.897
Philadelphia	0.041	0.030	0.035	0.354	0.424	0.424
Washington	0.014	0.003	0.009	0.290	0.086	0.290
St. Louis	0.261	0.111	0.186	2.266	1.080	2.266
Detroit	0.051	0.023	0.037	0.370	0.228	0.370

Abatement of Sulfur Dioxide Pollution

The principal SO_2 sources are smelters of sulfide ores and steam power plants burning fuel of high sulfur content. In the former category there are smelters handling over 400 tons of sulfur per day and in the latter plants burning over 1000 tons per day of coal of several percent sulfur. The sulfur burned in the residences and businesses of a city of 100,000 population can easily equal that of one of these large plants.

SO_2 limitation consists of either (a) removing the sulfur prior to oxidation so that SO_2 cannot be formed; (b) scrubbing SO_2 out of the flue gases; or (c) discharge of SO_2-bearing effluent only into winds of adequate diffusing capacity by varying SO_2 discharge in proportion to the ability of the atmosphere to dilute it without the occurrence of local areas of high concentration.

The first of these means is exemplified by the pre-treatment of coal by float and sink methods or coking to lower sulfur content in the coal or coke prior to burning. This method is the only one feasible for the individual residential or commercial fuel consumer.

Scrubbing flue gases is in use in several variations. Washing with an excess of water has the twofold disadvantage of requiring a very large washing equipment installation and a body of water into which to discharge large enough so that the acid discharged into it will neither unfavorably affect the aquatic life therein nor otherwise pollute it. Neutralization of SO_2 by a lime or similar alkali solution or suspension, without any effluent liquid discharge, involves both the disposal as waste of the resulting impure calcium sulfate, calcium sulfite or similar substance formed, and the continuous addition of make-up alkali to the system.

Concentration of SO_2 in a suitable absorbent solution such as ammonium sulfite-bisulfite, followed by treatment of the solution to recover the absorbed SO_2 as the pure gas, elemental sulfur, sulfuric acid or other similar pure salable product, necessitates the installation of a very costly chemical plant not always justified by the potential income from the sale of these products. These various scrubbing methods are of most use to steam power plants and large smelters.

Control of atmospheric SO_2 by meteorogical control of rate of discharge involves a partial plant shutdown when an unfavorable combination of wind turbulence, velocity and direction, and of convection currents exists. The degree of curtailment of plant output is held proportional to the estimate of the severity of these criteria. Local conditions must be thoroughly studied to establish these meteorological standards. Such a regime may be easily followed by a smelter but is impracticable in the case of steam power plants and similar fuel consuming sources.

Awareness of the benefits of holding atmospheric sulfur gases to low levels has reached the stage in England where all recently built public utility power plants have incorporated means for holding the effluent SO_2 to less than 50 ppm, which, in general, necessitates at least a 96% removal of sulfur from the flue gases. In this country, SO_2 abatement, as much as smoke abatement, influenced the city of St. Louis to allow only pretreated coal to be hand-fired. At the Trail Smelter in British Columbia, absorption

(Continued on page 122)

[7] Air Hygiene Foundation of America—Loc. Cit.

Practical Pointers on Industrial Exhaust Systems

By BENJAMIN S. MALIN
Mechanical Engineer
Captain, Corps of Engineers
U. S. Army

This section presents to the operating, installing or design engineer information on a lot of homely little problems that arise in connection with industrial exhaust systems, not ordinarily included in the more impressive compilations of data and information on design. Here the reader will not find charts on estimating system resistance but here he will find how to seal the fan shaft if blowback is noticed. Here he will not find data on recommended gauges for ducts, but he will find pointers on making explosion doors; nothing on velocities for various ducts, but practical notes on material traps. The section is made up of selected portions of the author's field notebooks.

BLOWERS AND EXHAUSTERS

WHERE the resistance of an exhaust or dust collecting system is difficult to calculate, or where there is a possibility that the capacity or system resistance may be increased as a result of later additions either to the load or system circuit, it is wise to provide adjustable-pitch driving pulleys. These may be obtained for various belt sections for one to six and more V-belts. They provide variations in speed of from 6 to 10% plus or minus the nominal speed, depending upon diameter. Pulleys may be selected for plus or minus the calculated fan speed, or for all plus or all minus, with the calculated speed at minimum or maximum diameter setting, respectively. Performance of industrial dust collecting systems may be readily and economically set, balanced or changed by these pulleys which sometimes save considerable time and money invested and in odd-pulleys of different diameters.

V-belt pulleys and belts should be selected in accordance with manufacturers ratings and for 50% overload to prolong belt life. Multiple groove pulleys should be provided with a matched set of belts inasmuch as belts picked at random have considerable variations in length and when used on multiple pulleys result in a non-uniform distribution of load. Care must be exercised in the arrangement and setting of each blower to conform to the recommended practice regarding tight and slack sides, direction of rotation, belt tightness, and relationship of pulley center levels.

In addition to carefully balanced blower wheels, fans and blowers operating at speeds in excess of 500 r.p.m. should be provided with statically and dynamically balanced sheaves. Unbalanced driven pulleys can cause a great amount of undesirable vibration which may develop cracks in the pipe joints and fan housing joints as well as reduce bearing and belt life. Cast iron sheaves may be satisfactorily balanced after installation, if necessary, by the addition of suitable clips or weights at the proper points on the rim, but this must be done by an expert, and at best the results are not so satisfactory as a factory balancing job.

All belt drives should be provided with heavy guards, covering the entire outside loop of the belt and the pulleys. Guards should be rigidly mounted so as to be very sturdy and yet be easily removable to change belts or adjust belt tightness. Panels may be of sheet metal, perforated, or expanded metal screens or wire cloth, but construction should be such as to prevent panel vibration. A suitable size round framed hole should be provided at each pulley center for the use of a tachometer or speed indicator.

Grooves of driving and driven pulleys should be accurately aligned before the system is put into operation. There are several methods by which this can be accomplished, though many millwrights and mechanics are familiar with only the eye sighting method, which is inaccurate. Care on this adjustment will pay dividends in longer belt life and more even wear on pulley grooves, particularly in multiple groove and adjustable pitch pulleys.

Housings of industrial exhausters are designed to provide a slight clearance around the fan wheel shaft so that binding and scoring of the shaft does not occur. An accurate fit is usually unnecessary in exhaust systems with single fans or in those not handling fine dust particles. However, where several fans operate in parallel, discharging into the same dust collecting equipment, a blowback of dust through this crack occurs at inoperative fans when others are running, due to the pressure existing in the systems. This pressure may cause some air to flow by a

poorly fitted cyclone inlet check damper of the inoperative system and carry dust through the discharge pipe back to the fan shaft and thereby constitute a nuisance as well as a fire hazard.

One excellent way to seal the shaft clearance without scoring or binding the shaft is to use a split collar of 3/16 to ¼ inch thick leather tapered in thickness toward the hole so that it is about 1/16 inch thick at the shaft and cut so that the hole has a diameter 1/16 inch smaller than the shaft diameter. The collar may then be attached to the fan housing plate by means of self tapping sheet metal screws or machine screws, with a metal ring or steel washers for stiffening as shown in Fig. 1.

Many manufacturers of fans and blowers recommend the complete removal of grease or oil from bearings and replacement of suitable fresh lubricant before putting units into operation. Where grease fittings are provided, care must be exercised to prevent overzealous grease gun operators from packing them too tight and thereby harming the bearing and highly ground surfaces and retaining rings.

Before operating motors it is good practice to blow out all motors and electrical apparatus with compressed air to remove foreign particles, such as metal trimmings, rivets, screws, and bits of metal which may have become lodged into small spaces.

Mounting bolts for fans and motors should be securely anchored and held tight to prevent horizontal movement often caused by vibration. Anchor bolts set in concrete should project through a length of pipe of size suitable to allow shifting the bolt to fit fan base holes accurately. Spaces around bolts should then be caulked tight.

Oil and grease cups of fan bearings should be readily accessible and clearly visible. Frequently tubing extensions are necessary to bring the cups within reasonable reach. Painting cups and tubing bright red or yellow helps insure adequate attention to requirements for regular oiling.

Industrial exhausters and blowers used in systems handling corrosive fumes and moist air will have a relatively short life unless their wheels, exposed shafts, and inside housing surfaces are protected by a suitable corrosion-resisting finish capable of withstanding the action of the chemical handled. There are a number of finishes available for this purpose some of which, however, are far better and more satisfactory than others. Air-dried sprayed or painted enamel finishes must be frequently renewed. Their use has not proved satisfactory due to the ultimate high cost and because of the shutdown time and labor factors involved in repeated applications. Synthetic resin baked-on enamel is far more satisfactory and will often last many years without attention. Some baked enamels however may chip or crack in handling or shipment or from vibration, especially in the larger size fans. For this reason the heavier gauges used in Class II fan and blower construction are frequently specified when baked-on finish is to be applied.

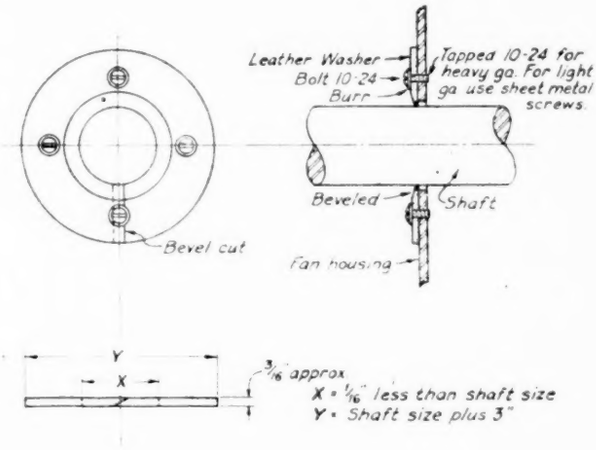


Fig. 1. Leather shaft seal for use with fans handling dust and dirt.

DUST COLLECTING AND SEPARATING EQUIPMENT

Cloth screen filters should be provided with a reasonable number of spare screens to be used as replacement of worn and torn cloths. Most collectors of this type require additional cleaning periodically by air jets or brushes, in addition to the usual regular rapping. This is especially true of filters handling very fine or hygroscopic dust which tends to absorb water and become sticky. Rapping alone is not always violent enough to shake off such accumulations completely. Great care must be exercised in cleaning by hand to avoid tearing the cloth. Suitable dust filter masks and dust-proof goggles should be standard equipment with every collecting system since frequent entry into the dust side chambers may be necessary.

Dust side chambers of cloth screen filters should be provided with explosion doors and water spray nozzles if the collected material is inflammable or likely to form explosive mixtures. Sprinkler heads with protected fusible links set to fuse at 165F are satisfactory. Deluge type open head dry pipe systems are particularly suited to outside installations where there is danger of freezing with wet sprinkler piping. The water flow may be started by the opening of a water deluge valve actuated by thermostats set in suitable places in the chamber. Either sealed bi-metallic, mercury tube or "rate-of-rise" type thermostats may be used depending upon the degree of sensitivity and rapidity of action desired.

Explosion doors should be of "strain free" plate glass with edges ground smooth so that no cracks might form as a result of vibration. Glass thicknesses of ⅛ inch and 3/16 inch are commonly used—the former for static pressures up to about 3 inches water gauge, the latter for pressures up to about 6 inches — either positive or negative. Glass panels should be set in welded angle iron frames on wood blocks with rubber or felt pads, and securely bolted. A screen of heavy gauge wire and about ⅜ to ½ inch square mesh should be mounted on both sides of the glass with a clearance of at least ½ inch to protect glass from breakage and keep glass from flying should an explosion occur.

Entrance and exit air fittings should be carefully designed and constructed to reduce air friction losses to a minimum. Gradual piping expansions and large low velocity connections mean smaller conversion losses from velocity head to static head, and vice versa. Double bank filters with large common dust side chambers afford very low loss operation since entering air can be slowed to approximately 1200 feet per minute through large fittings and introduced without a baffle rather than be carried at customary high velocities of 3200 to 4000 feet

per minute against an entrance baffle. A static regain can be achieved in each gradual expansion inlet fitting when high conveying velocities need not be maintained.

Though the dimensions and proportions of low pressure type cyclones have been determined by experience and practice in the field, there are some designs and sizing methods which are better than others. This subject is too involved to discuss here in detail, but the following points regarding cyclone selection, design and construction should, in the writer's opinion, be kept in mind:

Inlet pipes and fittings should be sized for velocities not exceeding 4000 feet per minute unless the required conveying velocity for the material handled is higher.

Inlet pipes should all be connected to the cyclone at the same point on the periphery and one above the other, if possible. If this cannot be accomplished, due to the placement of equipment or construction limitations, they should be staggered at different levels with a view toward minimizing interference of entering air streams. The greater the number of entering air streams the greater the interference. When connections are made at the same levels at different points on the periphery or at poorly selected points, the addition of vertical vane guides facilitates paralleling the air streams where they might normally join.

In general long cones of about 60° included angle are more efficient than shorter shallow ones in the separation of finer dust particles. A well proportioned cyclone has a cone length 80 to 90% of its largest diameter and a body height of approximately 65 to 75% of this diameter, depending on the type of material handled and the number of connections.

The inner guard diameter should be as large as possible to allow outlet velocities of 1000 to 1400 feet per minute. Guards should have both an adjustable sleeve section and an adjustable shallow conical disc if there is any doubt as to the exact level and size of the guard opening required for maximum effectiveness of separation. The bottom edge of the tubular guard should be at least 5 inches below the bottom of the lowest inlet fitting. The disc and tubular guard should both be braced to resist the twisting effect of the whirling air streams, if vertical vanes are used to straighten the air flow through the guard inlet. The adjustable features are especially desirable where only one stage separation of dust is provided in systems handling fine dust. Frequently close setting of these elements in a well designed cyclone can provide almost complete removal of dust from the air stream.

Cyclones are numbered and sized by the maximum diameter of an equivalent single discharge pipe. Where more than one pipe is to be connected to a given cyclone the areas of each pipe are added to determine the corresponding area of a single equivalent pipe. Generally it is safer to select the next larger size cyclone, rather than the minimum size required, so as to insure economical operation, low pressure loss, and provision for extra capacity for future additions.

Exit air from cyclone outlet pipes need not be delivered to free atmosphere but may be passed through second stage cleaning equipment such as cloth screen filters where extremely fine particles (as small as three microns) may be removed. This thorough clarification makes the air safe to breathe (provided it is not contaminated with gases) and it can then be returned to the manufacturing space. Re-use of this air is desirable in large systems to conserve fuel.

Large exhaust and dust collecting systems impose a heavy tax on boiler plant and refrigeration plant facilities and greatly increase operation expenses when the air handled is exhausted. Usually 80% or more can be recirculated and the remainder discharged to the outside to make room for an equal amount of fresh air. This make-up air can be introduced in a positive manner or by infiltration induced by lowered internal pressures in the manufacturing spaces.

Actual tests of recirculating air systems made by the author show that the temperature drop of the exhaust air in passing through outside piping, cyclone separator, and cloth screen filter is surprisingly small, being about 8F in zero weather. Air leaving the exhauster may be around 75 to 78F and seldom needs reheating, even after the 8F drop, if properly introduced into the room through a sufficient number of outlets at proper speeds and levels. There are a number of well established rules regarding this relationship. A good combination is an outlet velocity of 1400 feet per minute at a 12-foot level above the floor with diffusing vanes in the outlets. If ceiling heights are such that air must be introduced at lower levels many smaller size outlets with diffusing vanes are necessary to prevent drafts—with air at or near the 70F mark. Occasionally, in very severe cold weather, reheat may be necessary and can be provided by thermostatically-controlled finned tube steam coils in the return ducts. However, in manufacturing plants with normal machine density, sufficient motors, lights and personnel are housed to constitute an adequate heat source when 80% of exhaust air is recirculated.

Cyclones, filters and exhausters may be operated in parallel in circuits which have substantially the same resistance in their respective elements. With careful design and attention to correct grouping and pipe sizing, several fans may exhaust into one cyclone, several cyclones may discharge into one cloth screen filter and the outlet pipe of one cyclone may be split and the second stage cleaning load divided between two cloth screen filters, which in turn may be also handling the discharge of other systems, provided that all systems have circuits which are essentially equal in resistance or that they are nearly equal and are provided with balancing devices such as "squeeze" dampers to equalize the resistance in the various circuits. Balancing may be achieved by adjustable pitch drives and with use of suitable inclined tube draft gauges with static tips inserted at critical points. In large systems multiple arrangements provide the advantage of flexibility and keep equipment down to reasonable sizes as well as allow a more uniform distribution of equipment weights.

Inlet fittings to cyclones should be rectangular with gradual transformations from the round pipe. Careful construction of the check dampers is

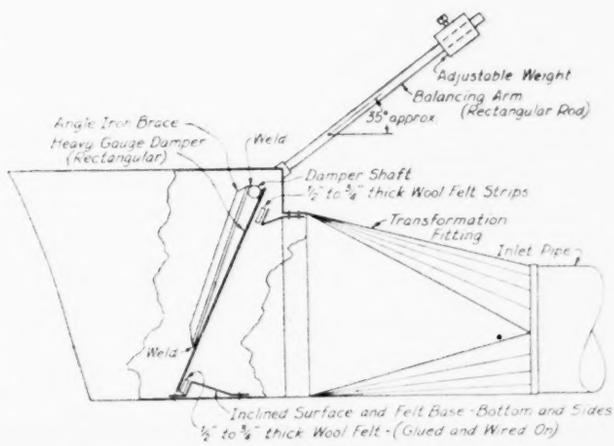


Fig. 2 Check damper for cyclone separator inlet. Damper is at 60° angle when closed.

very important especially when the cyclone handles the discharge of more than one system. To prevent leakage of air through the damper of a system not in operation, each damper should be made of heavy gauge metal so that it will remain rigid and seat tightly all around against heavily felted surfaces when closed. One method of achieving this is by the construction indicated in Fig. 2. Balancing arms should be provided with sliding adjustable weights by which the minimum load may be imposed on the fan in starting and holding the damper open—yet allow positive close seating when system is shut down.

False economy is often practiced in the construction of cyclones, particularly in the use of light gauge metal, insufficient rivets, lack of solder and lack of desirable features which provide uniform high efficiency operation. Price considerations in competitive bidding should not limit the quality and completeness of an installation if later dissatisfaction is to be avoided. Much needless extra time can be contributed by the contractor in patching up and straightening out little difficulties which might have been avoided by careful planning in the first place and attention to the many details.

Dust boxes under cyclones should be made of 16 gauge metal, preferably with standing seams for stiffening and angle iron frames for rigidity. Standing seams should be filled with both felt and mastic to prevent leakage of dust especially when cyclone is operating under pressure, as would be the case with a cloth screen secondary clarifier or return air system. Dust boxes under pressure "breathe" and vibrate, sometimes quite violently, and tend to loosen their seams. Boxes should be provided with well fitted dust tight explosion doors set into the upper space where dust is not likely to accumulate. Doors should be suitably weighted to resist opening under normal pressures but be free to operate under sudden surges of high pressure resulting from an explosion. Hinges should be of steel with brass pins and should be adequately protected against rain, snow or formation of ice, to insure operation at all times.

ACCESSORIES AND SPECIAL DESIGNS

Industrial exhauster wheels installed in dust collecting systems are likely to be damaged by large or heavy pieces of wood or metal which frequently find their way into exhaust piping. Metal objects, also, tumbling through the metal wheel and piping, can cause dangerous sparks. These pieces should be removed from the air stream automatically by a trap which is usually installed in the exhaust main piping or directly at the exhauster inlet.

Traps can be made in several designs utilizing the principles of momentum and inertia to remove the pieces from the air stream before they enter the exhauster wheel. A well designed trap should have a cross sectional area considerably larger than that of the pipe in which it is placed. If possible inlet and outlet fitting should be of gradual expanding type with low loss fittings. Deflector baffle plates set at an angle may be utilized to help divert large particles out of the air stream and are especially helpful when space is limited. Traps with abrupt 90° change in direction of air flow are sometimes used, but are costly in terms of added system resistance. Traps add from ½ to 1½ inches static pressure to system resistance depending upon velocities and design. High losses mean a considerable expenditure in horsepower required to overcome the restriction to air flow, and in calculating the over all resistance of a system the trap design should be carefully considered.

Present day systems for cleaning metals include a blasting process in which metal particles called shot or grit are sprayed at high velocities upon the surfaces to be cleaned. The grit is manufactured in various sizes, the most popular being 60, 90 and 120 mesh. Some grades of shot are chilled to increase hardness while others are annealed. The end result of this process is the breaking up of the shot as well as the breaking down of scale, rust and crusts on the metal parts processed. A great deal of fine dust is thereby generated and this must be rapidly removed and closely controlled.

Unfortunately in the process of drawing off the finer particles many others of larger size which are still useful as shot, are also carried off in the exhaust air of the average dust collecting system, and for this reason the process may prove more costly than necessary because of the waste.

Efficient operation of air exhaust systems for these grit blasting machines depends upon close regulation of the following:

Air velocities within the blast chamber;

Air velocities in the exhaust system piping, particularly at the connections to the machines;

Suction in pipes at connections to machines; and air volumes removed from machines.

Since there are several exhaust system connections on most machines, and each of which may have a different resistance and entrance coefficient, some means for regulat-

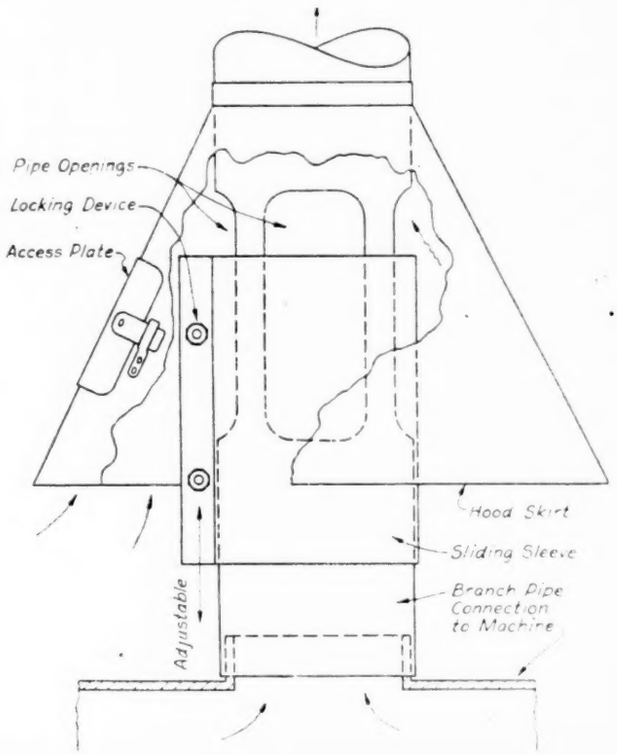


Fig. 3. Suction and velocity regulator for grit blasting machines.

ing the four variables listed must be provided. This means is required, in addition to the balancing dampers normally provided at each branch pipe of an exhaust system. Fig. 3 shows such a device. It is mounted in the pipe connection about 16 inches from the machine and operates as follows:

When sliding sleeve completely covers openings in pipe all air induced into the branch comes from the machine at maximum suction and velocity. When openings are partly uncovered, suction at machine connection drops and volume of air exhausted from machine is reduced. This is accompanied by a drop in velocity of the air leaving machine. The slower moving air tends to pick up only the lighter particles floating in the chamber, since the heavier ones drop down and out of the stream and thereby remain in the machine to be re-used. Regardless of the optimum setting of this sliding sleeve the volume of air moving through the pipe remains substantially constant since the coefficients of entry through the slots and through the machine are very nearly the same. The air volume originally set by the balancing dampers is therefore undisturbed.

To discourage interference by machine operators, who are often prone to manipulate dampers, the hood skirt shown is attached in a manner to hide the slots and slide almost completely. It does not interfere with air flow, however. A small access plate in this skirt is needed to allow a screw driver or wrench to be inserted for loosening and tightening the sleeve clamp. The slots can be three or four in number, having a total area equivalent to the cross sectional area of the pipe.

Fire dampers are frequently used at points where ducts or exhaust piping pass through walls or roofs, and at points of entrance and exit at dust collecting equipment. Their purpose is to prevent the spread of fire from one section of the system, or space, to another. They should be made of heavy gauge plate rather than sheet metal, should rest on angle iron ledges when closed, and held open by wire or chain with fusible links, of suitable melting point, placed in the air stream. Damper design should be such that the area of the duct is not materially reduced, and no large projections disturb the flow of air. Hinges should be of rugged construction with brass pins to assure operation at all times. Obviously the hinged type damper cannot be used in piping carrying large amounts of dust particles such as wood, or accumulations will form and clog the device. The sliding type damper, as illustrated and described in literature issued by the Underwriters Laboratories, can often be applied in pipes carrying dust.

Discharge stack caps have been made of the "Chinese hat" design for many years. While this is the simplest type of stack cover it has many disadvantages among which is its resistance to straight line upward flow of gases, smoke, and dusts. Heavy fumes and vapors strike the inverted V and are deflected downward and against the oncoming flow. Everyone is familiar with this reaction but few realize how easily it may be corrected. A remedy lies in the use of a double shallow disc, one slightly smaller than the other, and the smaller one inserted under the larger as shown in Fig. 4. The difference in diameter provides a rain lip which, though too small to influence the upward flow, provides a ledge from which water is shed before it can drip down the stack. The dimensional relationship is indicated in the table. This type of cap is satisfactory in its performance, especially where numerous undesirable discharges must be made in areas near residential districts. The stream envelops the cap smoothly and flows upward unimpeded. This cap will last much longer than the conventional type.

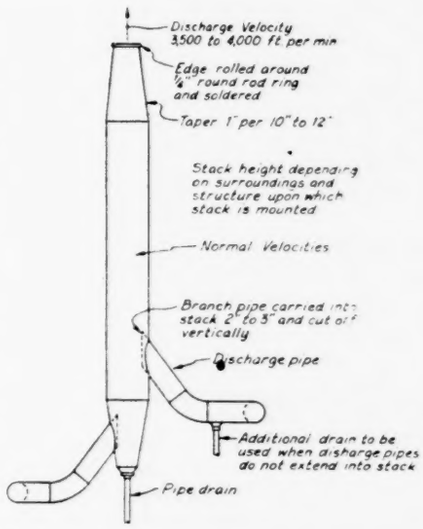


Fig. 5. High velocity discharge stack for handling gases, fumes, and nuisance dusts.

Discharge stacks handling objectionable nuisance, dusts, or gases may be designed in a manner to throw the air stream high enough to allow them to be rapidly dissipated at levels high enough to eliminate the possibility of settling in the immediate area. This is achieved with stacks of short length by reducing the stack diameter in the top section gradually to a size small enough to force the flow to leave at velocities of 3500 to 4000 feet per minute. A 24-inch stream at 4000 feet per minute will carry upwards a distance of over 50 feet. The larger the stream the

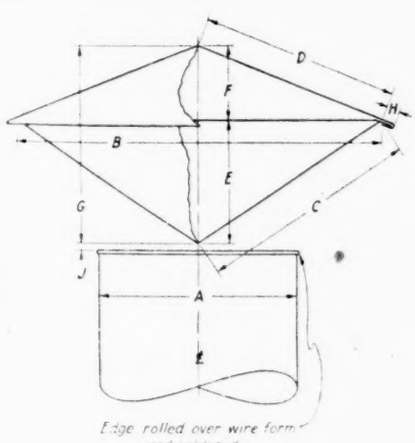


Fig. 4. Exhaust stack cap.

Discharge Pipe Size, Inches	U. S. Standard Gage, Galv. Iron	Dimensions, Inches							
		B	C	D	E	F	G	H	J
6	22	11¼	6¾	6	3¾	2¼	6	⅞	1½
7	22	13⅛	7⅞	7	4⅜	2⅝	7	⅞	1½
8	22	15	9	8	5	3	8	⅞	1½
9	22	16⅞	10⅛	9	5⅝	3⅜	9	⅞	1½
10	22	18¾	11¼	10	6¼	3¾	10	1	1½
12	20	22½	13½	12	7½	4½	12	1	1½
14	20	26¼	15¾	14	8¾	5¼	14	1	1½
15	20	28¼	16⅞	15	9⅜	5⅝	15	1	1½
16	20	30	18	16	10	6	16	1¼	1½
18	18	33¾	20¼	18	11¼	6¾	18	1¼	1½
20	18	37½	22½	20	12½	7½	20	1¼	1½
22	18	41¼	24¾	22	13¾	8¼	22	1¼	1½
24	18	45	27	24	15	9	24	1½	1½
26	16	48¾	29¼	26	16¼	9¾	26	1½	1½
28	16	52½	31½	28	17½	10½	28	1½	1½
30	16	56¼	33¾	30	18¾	11¼	30	1½	1½
32	16	60	36	32	20	12	32	2	1½
34	16	63¾	38¼	34	21¼	12¾	34	2	1½
36	16	67½	40½	36	22½	13½	36	2	1½

further it will travel before its energy is completely dissipated.

The acceleration from relatively low pipe velocity to the higher discharge rate must be accomplished as

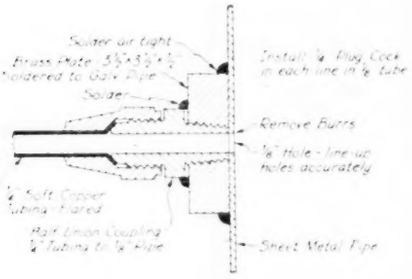

Soldered air tight
Brass plate 3½"x3½"x⅛"
Soldered to G.I. Pipe
Solder
Install ⅛" Plug Cock in each line in ⅛" tube
Remove Burrs
⅛" Hole - line up holes accurately
¼" Soft Copper Tubing Flared
Half Union Coupling ¼" Tubing to ⅛" Pipe
Sheet Metal Pipe

Fig. 6. Static pressure connection.

a change from static pressure to velocity pressure. For example, the theoretical static pressure required for a change in velocity from 2000 ft per min to 400 ft per min is 0.75 inches w.g. This load must be added to the system resistance in determining the blower speed. If this is not done the restriction will reduce the air volume handled until an equilibrium at lower capacity is reached.

The stack should be designed and constructed substantially as shown in Fig. 5. It should be noted that the branch pipes extend into the stacks a few inches and that each branch is cut off on a vertical so that water which may drain down the stack will not mix with and cake up dust particles. This latter precaution need not be taken if only fumes are conveyed.

Frequently dust storage boxes in industrial exhaust systems must be unloaded while in operation. During this time the entire system may be under sufficient pressure to cause dust to be violently blown out of any opening made to remove the accumulations. There is a tendency for engineers to overlook the necessity for carefully designing the chutes, dampers, and clamping devices which are necessary to insure satisfactory operation. The writer has designed several unloading systems which are air and dust tight, under static pressures of 5 to 6 inches of water during loading into closed truck bodies. Experience gained in these installations served to emphasize the need for extra heavy parts, heavily felted seals, and rigidly braced dampers and substantial clamping devices.

To facilitate testing and balancing systems, numerous permanent static pressure connections should be provided at various critical points. These connections may be made of ¼ inch copper tubing and brass fittings, as shown in Fig. 6, with plug cocks in each copper tubing section. Portable draft gauges may be connected at these points for occasional readings, and permanent ones at critical points where routine check readings are taken.

Holes for pilot tube tests may be made in heavy gauge pipes by drilling holes and tapping them. When not in use they may be plugged with short round head machine or stove bolts.

Much has been written concerning exhaust hoods for use on metal finishing tanks with solutions required for chrome, nickel, copper and cadmium plating and in the Parkerizing and Pentrating of metals. Several arrangements have been presented in technical treatises. Probably the most popular and best of these is the narrow slotted hood opening on two or more sides of the tank near the upper edges. However, a study of air flow under-suction will reveal that very little air movement can be induced at any point more than about 18" from a source of suction or air intake. Slot velocities in the very high ranges of 2500 to 3000 f.p.m. and more have little more effectiveness than velocities of 1800 to 2000 f.p.m. and for this reason slots are built on two, three and frequently four sides on the larger tanks.

Sometimes tanks are built 4 and 5 feet wide and even larger and slots on all sides cannot always be installed due to space limitations and interference with manipulations by the operator. Moreover, heavy fumes such as those of chrome solutions are less easily induced to flow into the hood slots, while rapidly rising water vapor from hot solutions is often out of reach of the induction effect of the air moving toward the slots.

With these limitations in mind the author conducted a series of experiments to determine a suitable and economical way of utilizing the push-pull system of exhaust, with only one hood on the back side of tanks of any width. Results of numerous combinations and arrangements have shown the following relations to be most effective:

(a) An air curtain sweep across a tank up to 6 feet wide should consist of a 1½ to 2 in. steel pipe with 5/32 to 3/16 in. diameter holes spaced at intervals of 2 to 2½ in. and discharging streams across the tank at an angle of approximately 5 degrees below the horizontal.

(b) Air pressure within the pipe should be about ¼ pound per square inch or approximately 7 inches of water. At this pressure, if the holes have been properly drilled, the air should leave the pipe at velocities of about 9,000 f.p.m. and carry a distance of not less than five feet before the energy of flow is dissipated. The air curtain increases in volume by the addition of aspirated air as it moves across the tank. On the opposite side, the flow is induced further by action of the air entering the exhaust hood. The operation is smooth and uniform and the rapidly rising steam as well as the sluggish heavy vapors are caught and moved toward the hood.

(c) Air should be supplied by means of a separate air feed system utilizing a centrifugal blower of the constant pressure-variable volume type selected for pressures of ½ to ¾ pounds per square inch, depending upon the length of piping needed and its corresponding resistance. Air volumes needed for this sweep air system can be calculated at 8 c.f.m. per foot of tank length, so that a 150 c.f.m. blower can handle the load for almost 20 feet of tanks. This is considerably less than the customary sweep air volumes thought to be necessary in the past where a narrow slot was used instead of small round streams under higher pressure.

(d) A typical exhaust hood with double slots for this type of system is shown in Fig. 7. The height of the hood is not a fixed dimension but may vary with the tank width, the higher hoods for wider tanks. Slot

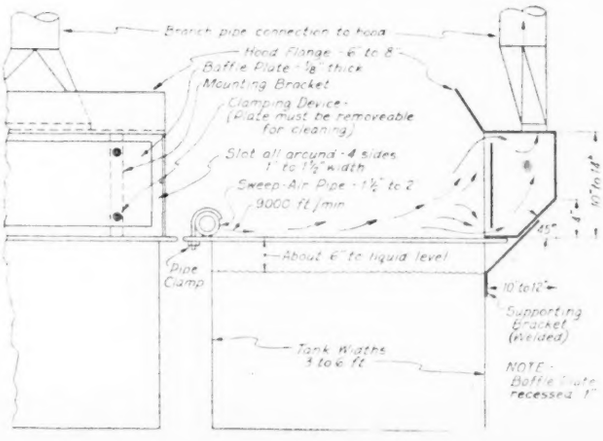

Branch pipe connection to hood
Hood Flange - 6" to 8"
Baffle Plate - ⅛" thick
Mounting Bracket
Clamping Device - (Plate must be removeable for cleaning)
Slot all around - 4 sides 1" to 1½" width
Sweep-Air Pipe - 1½" to 2"
9000 ft./min
About 6" to liquid level
Pipe Clamp
10" to 12"
Supporting Bracket (welded)
Tank Widths 3 to 6 ft
NOTE: Baffle Plate recessed 1"

Fig. 7. Exhaust hood for liquid tanks with sweep air curtain for extra wide tanks.

widths are usually 1 inch but may be 1¼ or 1½ inches for larger tanks requiring more exhaust air. Slot velocities need not exceed 2000 feet per minute. The front plate should be removable for cleaning purposes and the entire assembly should be made of welded 16 gauge black iron sheets rather than of galvanized sheet iron or steel of lighter gauge. Hoods can be protected with suitable corrosion-resisting paint if necessary.

The most effective tank exhaust systems without sweep air have been designed with air quantities of 200-250 c.f.m. per square foot of liquid surface area. With the sweep-air system described herein superior results are achieved with exhaust air quantities of only 90 to 140 c.f.m. per square foot of liquid surface area. This considerable saving in equipment size, duct work, horse power requirements, etc., greatly offsets the first cost of the added supply-air system and pays substantial dividends in reduced operating, maintenance, and replacement costs.

Many exhaust and dust collecting systems which do not recirculate the cleaned air likewise do not have any positive means for replacing the air which is removed from the space. As a result, the fan builds up a negative pressure, sometimes as high as 9 or 10 inches of water vacuum, in the plant. This pressure difference causes air to infiltrate through cracks around windows and doors. Usually the infiltration rate is not sufficient to satisfy the requirements of the system and the difference in pressure continues while the air flow is reduced often below the quantity necessary to maintain the required conveying velocities. For this reason the material often settles in the pipes.

Pressure relief dampers set into spaces in the windows and walls are the obvious solution to this problem. Dampers should have multiple blades of 16 to 18 gauge metal and should be linked so that they open and close together. Counterweighting should be adjustable so that a difference in pressure of 0.2 inch of water allows blades to open. Pivots should be mounted near the top of each blade and should be of brass mounted in steel or steel pins mounted in brass to facilitate easy operation, without lubrication.

Finned tube steam coils are sometimes used in conjunction with relief air dampers to keep entering air at a reasonable temperature in winter. "Non-freeze" steam distributing tube coils and duct-type air stream thermostats actuating modulating steam valves provide the most satisfactory regulation and control. Face and bypass dampers can also be used but are not as satisfactory inasmuch as with this arrangement the steam coil is always "wide open" and the entering air is made up of two stratified streams—one heated and the other not.

NOTES ON SAFETY DEVICES

In addition to the safety devices already described such as material traps, sprinkler heads, fire dampers, explosion doors and windows, and belt guards, there are a few additional devices which will increase the protection of and facilitate operating industrial exhaust systems.

One of these is a set of emergency "stop" switches of the large red push-button type placed at some accessible point at which electric circuits to all apparatus, remote or near, may be opened at once in case of fire, accident or other trouble. These buttons should be protected against accidental operation by a heavy bar iron guard but should be easily visible and generally known by all key employees.

Another precaution which should be taken is to eliminate the possibility of sparking caused by static electricity at fan pulleys. This can be done by connecting motor bases with fan bases by means of a heavy wire or angle iron brace. In addition the entire system including outside dust collecting equipment and piping should be grounded as a measure of protection in case they are struck by lightning.

None of the devices so far mentioned provides the operating engineer with a quick clue as to what may have happened when an emergency such as a fire occurs. The rate of burning may be so slow as to go on undetected for some time, and even then may be difficult quickly to trace to the point of origin.

Electric thermostats may be used to provide this last degree of protection. These units may be placed in the dust chambers under the cyclones and in the cloth screen collectors so that they may operate to detect a sudden rise in temperature or an excessive temperature. They may be used to actuate an annunciator or light panel to show the location of a "hot spot," or an alarm bell or siren, or to release dampers, or last, but not least, to open the circuit to the electric motors operating the system. Thermostats used for this purpose should function at temperature lower than that of the fusible links which are employed in sprinkler heads mounted in the same space. Recommended settings are 135F and 165F, respectively, for air at normal temperatures in dust collecting systems.

CONSTRUCTION — INSTALLATION

All sheet metal piping should be straight and present a smooth interior surface with laps at joints made in the direction of flow. Piping should be made substantially air tight with correct rivet sizes and spacing and soldering of joints on the outside—except as otherwise mentioned for more severe use. Transitions, offsets, enlargements and changes in directions should be made with long sweeps or long radii wherever space permits. Pipe laps shall be ample and in accordance with approved practice. Pipe interior surfaces should be free of all projections such as burrs, screws, braces.

Supports for piping should be of the rigid type joined to a split ring pipe clamp. Bandiron supports are not satisfactory since they do not prevent weaving and vibration which is inherent in any system handling dust, shavings, etc. Spacing of supports should not exceed 12 feet. Large size elbows with small radii often sustain a considerable thrust imposed by the moving air and sometimes must be braced to resist this force; otherwise resultant vibration may break the rivets and crack the solder seal. Pipes larger than 50 inches in diameter should be stiffened with angle iron rings set at intervals of not more than 5 feet and thoroughly riveted.

Elements such as plenums, material traps, and return air ductwork, which are made with flat panels, should be thoroughly crossbroken or braced with angle irons to prevent drumming, breathing and rattling especially where air velocities exceed 1500 feet per minute.

Button punching of standing seams is not a satisfactory substitute for bolts and nuts where strength, tightness and resistance to vibration are necessary. Its use in dust collecting system fabrication should be, therefore, very limited.

Each individual branch pipe and many submains should be fitted with balancing dampers. These should incline in the direction of air flow at an angle of 30 to 45 degrees where possible—never at right angles. The best location is in the branch near where it joins the main. The best position in a horizontal pipe is entering from the top; or, if this is not possible, from the inside of the V

formed by the junction of the pipes. Part of the end of the slide should be trimmed off in either case so that the flow in the branch may not be completely blocked even with the damper slide in. Slides should be of 16 gauge metal, should fit their frames snugly and have a suitable clamping device which will not shake loose and which will prevent excess leakage at the damper.

Piping and all sheet metal work installed outdoors should be constructed in a manner to facilitate the shedding of rain so that water accumulations do not form to cause rusting. Motors and chain drives when mounted outside should be protected against weather by shields, flashing, covers, and gutters to avoid rain pockets.

Access doors and cleanout doors serve a very useful purpose in the operation and maintenance of exhaust systems. Pipe mains should have such openings about every 15 feet. Dust storage boxes, cyclones, damper boxes, etc., should be provided with large access doors. Light weight doors with flimsy clamps which are not tight fitting will prove unsatisfactory. Hinges on outside doors should be protected against rain, if possible. Heavy wool felt, $\frac{1}{4}$ inch thick and one inch wide, is very satisfactory as a gasket material and gives best results when both glued and wired or bolted on. Access doors should be provided for the inspection of moving parts as well as for removal of dust from storage boxes when automatic means is inoperative or dust is caked up. A detachable sleeve or over-lapping draw band may be used on round pipes in lieu of access doors especially in pipes entering and leaving exhausters.

Canvas connections for dust collecting systems should be heavy—at least 22 ounces—and preferably treated to resist absorption of moisture if they are to be used outside. In attaching canvas, bolts, nuts and washers are not enough. Canvas should first be folded around 3/16 by $1\frac{1}{4}$ inch bandiron, the running end stitched to the standing side and then attached by means of bolts through both canvas and bandiron as shown in Fig. 8.

Interference between exhaust piping and piping of other services such as water, steam, and drain, is sometimes inevitable but can be largely avoided by careful planning and construction. It is not good practice to run smaller steel pipes through sheet metal piping due to the difficulty of properly caulking the joints and because of interference with air flow inside. Sharp offsets in air piping should be avoided.

In general elbows should be of the long radius type with center line radius at least twice the diameter of the pipe. They should be constructed of metal two gauges heavier than the pipe in which they are placed so as to provide for extra wear. Exceptions to this rule are when the entire pipe is constructed of heavy gauge metal, such as 16 gauge, which is used in large pipes, or in pipes handling abrasive material.

An exception also applies in systems having pipes coated with corrosion resistant paint, as in the case of exhaust systems handling acid and alkali fumes. Ninety degree elbows constructed of only three or four sections should not be used in dust collecting systems.

Branch mains or branch pipes may enter the mains at either taper sections or in the straight runs, but care should be exercised to avoid bunching of tee connections, which would not only weaken the section but cause converging streams to interfere with each other.

Other details of construction which require careful planning include: methods of mounting dampers on rods; clamping devices for damper-adjusting rods; provision for sleeves through floors; location and placement of ladders, walk-ways and platforms; design, placement and size of hoods; flashing of bases, pedestals, and roof openings

Ductwork and piping handling corrosive fume-laden air or hot moisture should also be protected both inside and outside with two or three coats of corrosion-resistant paint. Without this treatment replacement of entire sections may be required as frequently as every five or six months, depending on the concentration of fumes, pitch of pipes, etc. Best recommended practice for piping is: use somewhat heavier gauges than for normal needs; provide long laps both in longitudinal seams and in joints; edge coat all cut edges with solder; solder both inside and outside joints and paint all surfaces both inside and outside with suitable paint. In addition piping should be pitched so as to drain off condensed vapors rapidly. Drain connections should be set into the bottom of the piping at suitable points for effective removal. Where drain connections are tapped into piping at higher pressure or higher suction points, a water leg trap of suitable height may be inserted to prevent movement of air through the drain piping.

Before any system is started all foreign material, such as metal trimmings, bolts, nuts, pieces of wood, canvas, cement, which has found its way into the piping should be swept or blown out. All dampers should be set in open positions, and draft gauges connected to static tips. Belt guards should be in place and all control points carefully and completely identified and marked by tags or labels. Bearings should be greased or oiled and safety devices and alarms tested and energized. Sufficient suitable ladders, drills, extension cords, plugs and the tools and instruments for testing should be on hand. All tools for adjustment of pulleys, movement of motors, etc., should be provided, as well as extra oil and filling funnel for draft gauges. In addition contractor should furnish sufficient mechanics to perform odd jobs.

Permanent electric fixtures should be provided near the operating equipment and wherever routine readings are taken. Electric outlets should be provided at other necessary points. Portable vapor-proof or explosion-proof lamps are sometimes desirable in trouble shooting.

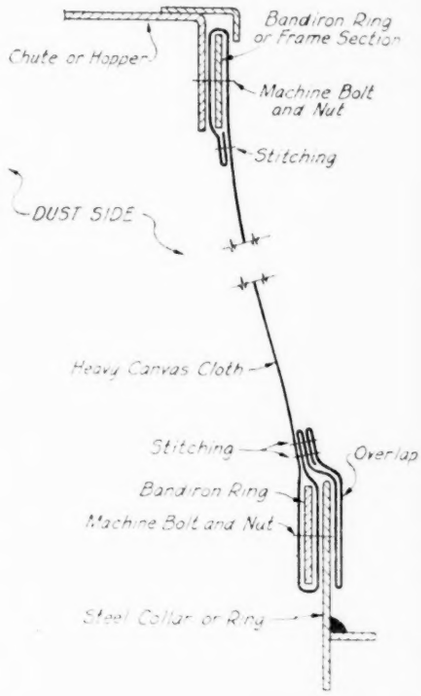


Fig. 8. Dust tight canvas connections.

Graphical Determination of Heat Transfer Film Coefficient for Sulfur Dioxide†

B. F. RABER* and F. W. HUTCHINSON**

CONTINUING the series of heat transfer articles, this month's installment presents two film coefficient graphs for liquid sulfur dioxide and a tabulation of film and wall resistances for *Type K Standard Tubing*. In addition, the text of the article discusses some of the extensions which are possible of the data from the two fundamental graphical solutions. Use of the graphical solutions and of the tabulation is exactly as in the cases—already discussed—of water and ammonia; for purposes of review, however, the method will be demonstrated by means of a numerical example:

Problem: Liquid sulfur dioxide at 150F and at a velocity of 2 feet per second flows outside a pipe of ¾ inch outside diameter. The liquid SO_2 within the pipe is at 125F and flows with a velocity of 5.5 feet per second; inside diameter of pipe is ½ inch. Determine the inside and outside film coefficients.

Solution: Following the arrows along the dashed line on Fig. 5 leads to $h_i = 780$ Btu per hr per F per square foot of inside surface. If the fluid within the pipe were being cooled instead of heated the film coefficient would be 725 Btu per hr per sq ft per F. Similarly, the value of h_o is determined from Fig. 6 by following the arrows along the dashed line to read $h_o = 370$ Btu per hr per F per sq ft of outside surface. For this latter case the coefficient has the same value whether the fluid is heating or cooling.

Problem: If heat exchange in a problem similar to that above were occurring through ¾ in. (nominal) diameter Type K admiralty metal standard tubing and if flow conditions were such that h_i and h_o were found (from Figs. 5 and 6) to be 1000 and 800, respectively, determine the rate of heat exchange in Btu per hour per lineal foot per F fluid-to-fluid temperature difference.

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†Similar articles on water and ammonia appeared in the December, 1944, and January, 1945, issues of HEATING AND VENTILATING.

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TABLE 2.—THERMAL RESISTANCES PER LINEAL FOOT OF TYPE K STANDARD TUBING

(r_i = Inside film resistance; r_p = pipe wall resistance; r_o = outside film resistance; h = film coefficient of heat transfer from charts)

Material*	Tubing Diameter, Inches																			
	¼		½		¾		1		1½		2		2½		3		3½		4	
	Values of r_p																			
E.Cu.[1]	.000131		.000119		.000113		.0000857		.0000650		.0000570		.0000526		.0000507		.0000480		.0000470	
P.Cu.[2]	.000159		.000144		.000137		.000104		.0000790		.0000692		.0000639		.0000615		.0000583		.0000572	
R.Br.[3]	.000341		.000311		.000293		.000224		.000170		.000149		.000137		.000132		.000125		.000123	
C.Br.[4]	.000424		.000386		.000365		.000278		.000211		.000185		.000170		.000164		.000156		.000153	
Y.Br.[5]	.000430		.000392		.000370		.000282		.000214		.000188		.000173		.000167		.000158		.000155	
Mz.M.[6]	.000407		.000370		.000350		.000267		.000202		.000177		.000163		.000158		.000149		.000146	
Ad.M.[7]	.000464		.000422		.000395		.000304		.000230		.000202		.000187		.000180		.000170		.000167	
Cu.N.[8]	.00175		.00159		.00150		.00114		.000868		.000762		.000702		.000676		.000641		.000629	
h	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o
50	.246	.204	.145	.122	.103	.0874	.0766	.0678	.0516	.0472	.0390	.0360	.0313	.0291	.0263	.0244	.0226	.0211	.0198	.0185
100	.123	.102	.0725	.0610	.0513	.0437	.0383	.0339	.0258	.0236	.0195	.0180	.0157	.0145	.0131	.0122	.0113	.0105	.00990	.00927
200	.0614	.0509	.0363	.0305	.0251	.0219	.0192	.0170	.0129	.0118	.00975	.00900	.00784	.00727	.00657	.00611	.00564	.00527	.00495	.00463
300	.0409	.0336	.0242	.0203	.0171	.0146	.0128	.0113	.00860	.00785	.00650	.00600	.00522	.00485	.00438	.00407	.00376	.00352	.00330	.00309
400	.0307	.0255	.0181	.0153	.0128	.0109	.00958	.00847	.00645	.00589	.00487	.00450	.00392	.00364	.00328	.00306	.00282	.00264	.00248	.00232
500	.0246	.0204	.0145	.0122	.0103	.00874	.00765	.00678	.00516	.00472	.00390	.00360	.00313	.00291	.00263	.00244	.00226	.00211	.00198	.00185
600	.0205	.0169	.0121	.0102	.00855	.00728	.00639	.00565	.00430	.00392	.00324	.00300	.00261	.00242	.00219	.00204	.00188	.00176	.00165	.00154
700	.0175	.0145	.0104	.00871	.00733	.00623	.00547	.00485	.00368	.00336	.00278	.00257	.00224	.00208	.00188	.00175	.00161	.00151	.00141	.00132
800	.0155	.0127	.00906	.00768	.00641	.00545	.00478	.00424	.00322	.00294	.00243	.00225	.00196	.00182	.00164	.00153	.00141	.00132	.00124	.00116
900	.0136	.0113	.00805	.00677	.00569	.00485	.00426	.00377	.00286	.00262	.00216	.00200	.00174	.00162	.00146	.00136	.00125	.00117	.00110	.00103
1000	.0123	.0102	.00728	.00610	.00513	.00437	.00383	.00339	.00258	.00236	.00195	.00180	.00157	.00145	.00131	.00122	.00113	.00105	.000990	.000927
1100	.0112	.00925	.00659	.00555	.00467	.00395	.00348	.00308	.00234	.00214	.00177	.00163	.00142	.00132	.00119	.00111	.00102	.000959	.000900	.000843
1200	.0102	.00848	.00604	.00508	.00427	.00364	.00319	.00282	.00215	.00196	.00162	.00150	.00131	.00121	.00109	.00102	.000940	.000879	.000825	.000772
1300	.00945	.00733	.00557	.00469	.00395	.00336	.00294	.00261	.00198	.00181	.00150	.00138	.00121	.00112	.00101	.000940	.000868	.000811	.000761	.000714
1400	.00877	.00726	.00517	.00436	.00366	.00312	.00273	.00242	.00184	.00168	.00139	.00128	.00112	.00104	.000939	.000873	.000806	.000754	.000717	.000661
1500	.00819	.00679	.00483	.00406	.00342	.00290	.00255	.00226	.00172	.00157	.00130	.00120	.00104	.000971	.000876	.000815	.000752	.000703	.000660	.000618
1600	.00769	.00635	.00453	.00381	.00320	.00272	.00239	.00212	.00161	.00147	.00122	.00112	.000980	.000910	.000821	.000764	.000705	.000659	.000618	.000579
1700	.00713	.00599	.00426	.00359	.00302	.00256	.00225	.00199	.00152	.00138	.00115	.00106	.000923	.000857	.000774	.000719	.000664	.000620	.000582	.000545
1800	.00632	.00565	.00403	.00339	.00285	.00242	.00212	.00188	.00143	.00131	.00108	.00100	.000871	.000810	.000730	.000679	.000626	.000586	.000550	.000515
1900	.00646	.00535	.00381	.00321	.00270	.00230	.00201	.00178	.00136	.00124	.00102	.000947	.000825	.000766	.000692	.000644	.000593	.000555	.000521	.000488
2000	.00614	.00509	.00363	.00305	.00251	.00219	.00192	.00170	.00129	.00118	.000975	.000900	.000784	.000727	.000657	.000611	.000564	.000527	.000495	.000463

*Due to space limitations the materials below are abbreviated: [1]Electrolytic copper; [2]Phosphorized copper; [3]85% Red brass; [4]Cartridge brass; [5]66% Yellow brass; [6]Muntz metal; [7]Admiralty metal; [8]30% Cupro-nickel.

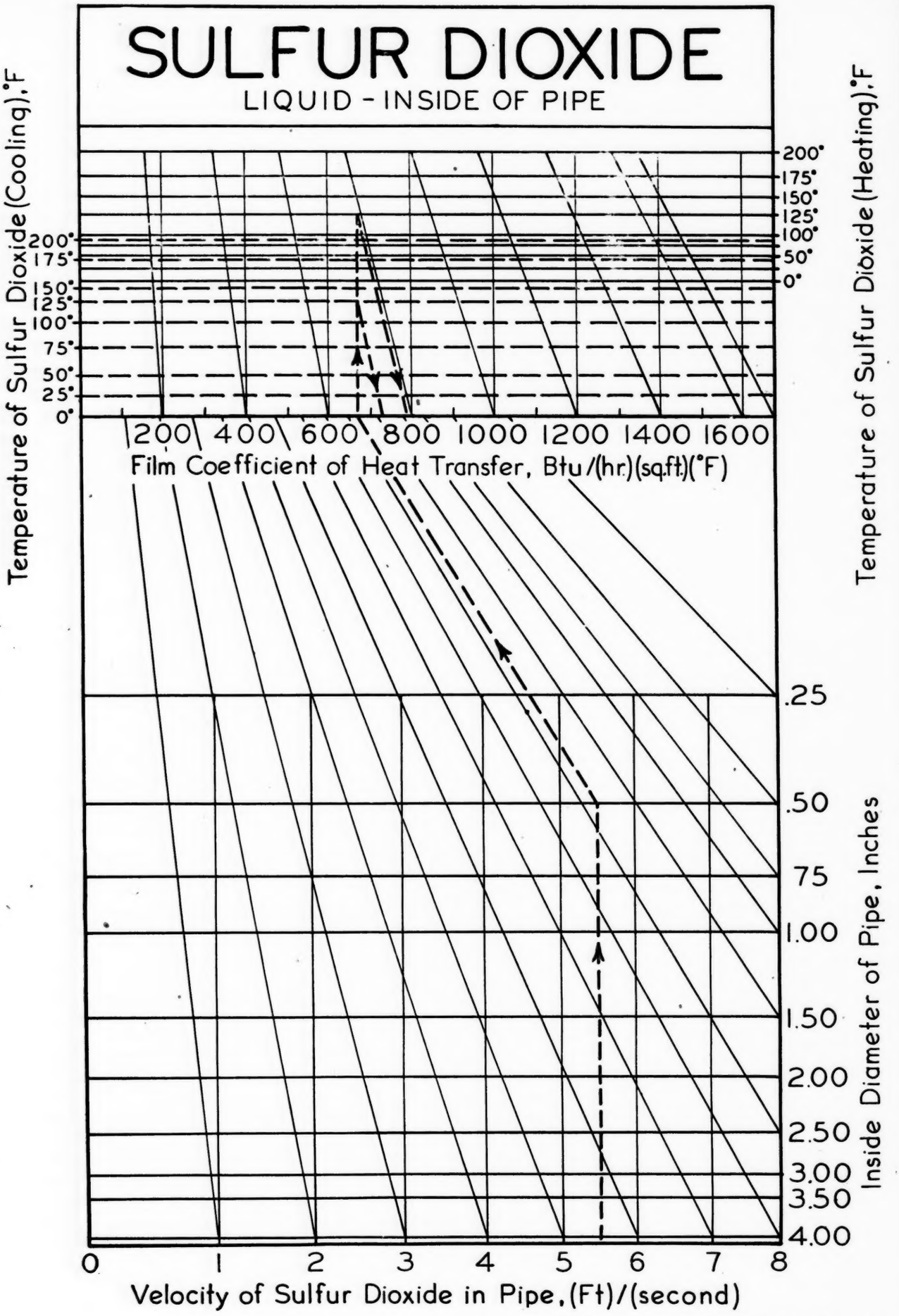

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Fig. 5. Film coefficient for sulfur dioxide flowing inside a pipe.

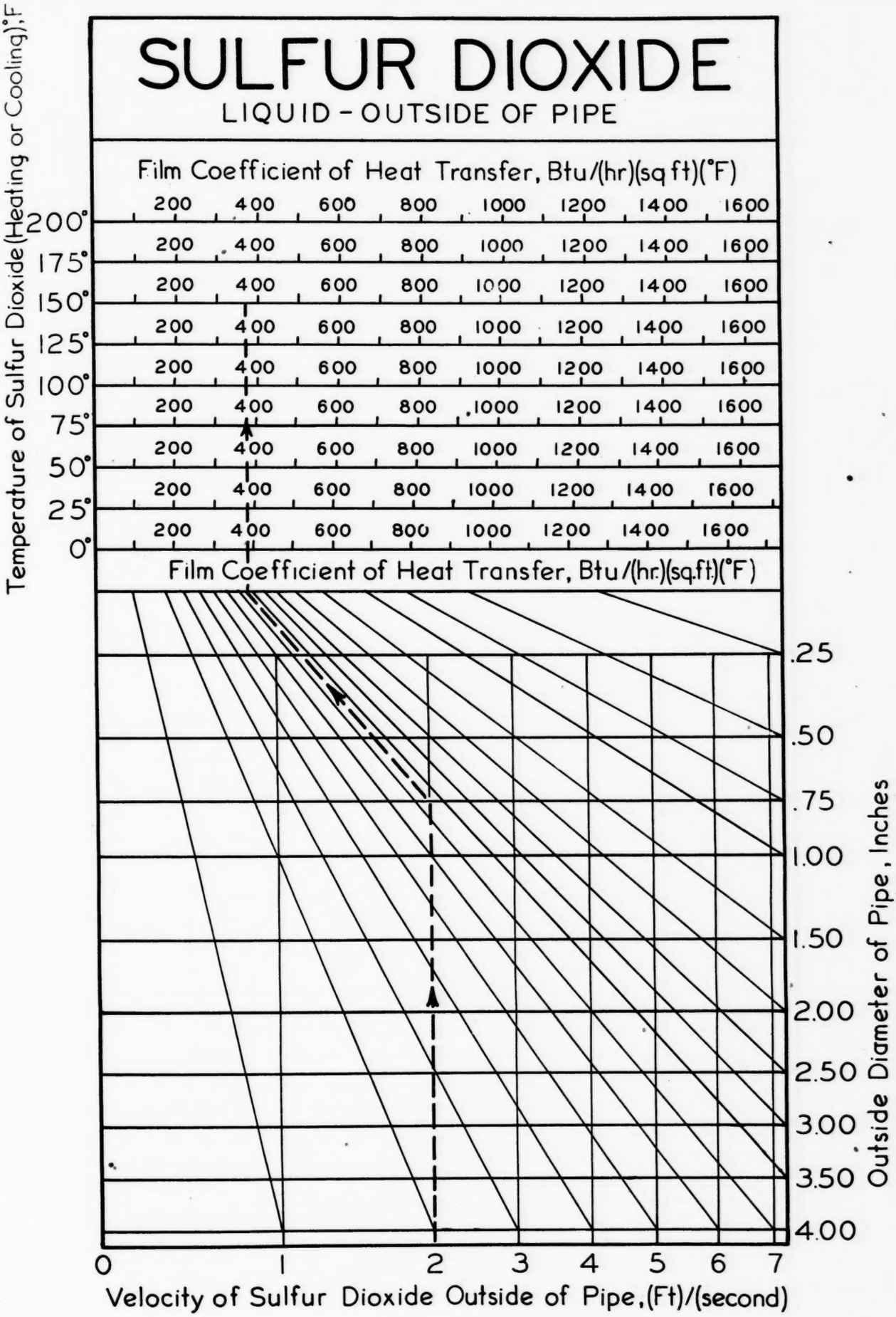
SULFUR DIOXIDE
LIQUID - OUTSIDE OF PIPE
Film Coefficient of Heat Transfer, Btu/(hr)(sq ft)(°F)
200 400 600 800 1000 1200 1400 1600
200° 175° 150° 125° 100° 75° 50° 25° 0°
Temperature of Sulfur Dioxide (Heating or Cooling), °F
Film Coefficient of Heat Transfer, Btu/(hr)(sq.ft.)(°F)
.25 .50 .75 1.00 1.50 2.00 2.50 3.00 3.50 4.00
Outside Diameter of Pipe, Inches
0 1 2 3 4 5 6 7
Velocity of Sulfur Dioxide Outside of Pipe, (Ft)/(second)

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Fig. 6. Film coefficient for sulfur dioxide flowing outside a pipe.

Solution: Refer to Table 2 for Type K tubing[1], enter at $h_i = 1000$ and read $r_i = .00513$ for ¾ inch nominal diameter. Similarly, entering at $h_o = 800$, read $r_o = .00545$ for ¾ inch tubing. Then read $r_p = .000395$ for ¾ inch nominal admiralty metal tubing. The fluid-to-fluid resistance is then $r_i + r_p + r_o = .00513 + .000395 + .00545 = .010975 = R$; then the over-all coefficient of heat transfer is $U = 1/R = 1/.010975 = 91$ Btu per hr per F per lineal foot of tube.

Extensions of Basic Data

Many practical problems require the evaluation of film coefficient for conditions which do not correspond to the two fundamental cases for which graphical solutions have been presented. When such problems arise the alternatives are to develop entirely new correlations based on experimental determinations under test conditions such as exist in the actual problem, or to provide some approximate method of correcting the data obtainable from the fundamental graphs. The latter procedure is the one which is presented here, but the user should not lose sight of the fact that in resorting to such correction factors an approximation is necessarily introduced into the results. The basic graphs give data which are in exact agreement with most widely accepted modern theory; the corrections give results which differ from values recommended by some heat transfer authorities but are in general, and approximate, agreement with the consensus of present day opinion.

A. Flow in Annular Spaces. This condition is of great practical importance because it includes the entire range of problems which relate to double-pipe exchangers as well as to those problems in which flow occurs parallel to the tube bundle in a shell-and-tube heat exchanger. While no generally accepted and thoroughly tested procedure is available, the method which seems to be most rational and which is frequently used in practice is to treat the annular space as equivalent to a pipe of size such that the ratio of pipe cross-section area to pipe surface area has the same value as for the actual exchanger. Thus,

$$\frac{A}{P} = \frac{(\pi d_e)^2}{4d_e} = \frac{d_e}{4} \text{ or, } d_e = \frac{4A}{P} \quad \ldots\ldots\ldots\ldots (1)$$

where

A = cross-section through which fluid is flowing, sq ft, and

P = square foot of transfer surface per lineal foot of pipe.

1. For the annular space of a double pipe exchanger, the above equation gives

$$d_e = 4\left[\frac{(\pi d_o^2 \div 4) - (\pi d_i^2 \div 4)}{d_i}\right] = \frac{d_o^2 - d_i^2}{d_i}$$

where d_o is the inside diameter of the outside (layer) pipe while d_i is the outside diameter of the inside (smaller) pipe. The equivalent diameter, d_e, is the value to be used in obtaining from the graph for film inside a pipe the film coefficient for heat transfer from fluid in the annular space to fluid flowing in the smaller pipe.

2. For flow outside and parallel to a tube bundle. Equation 1 gives a d_e for this case based on P equal to the sum of outside circumferences of all tubes in the bundle and A equal to the cross-section area of the shell less the sum of cross-section areas (based on outside diameters) of all tubes in the bundle. Thus,

$$d_e = 4\left[\frac{\pi d_s^2}{4N\pi d_t}\right] = \frac{d_s^2}{Nd_t}$$

where d_s and d_t are diameters (inches) of shell (ID) and of tube (OD) and N is the number of tubes.

Problem: Liquid sulfur dioxide is cooling while flowing outside and parallel to tubes of a shell-and-tube exchanger having a 7 inch shell and 20 1-inch tubes. Fluid temperature is 75F and velocity is 3 ft per sec. Find the film coefficient h.

Solution: Equivalent diameter, $d_e = (7^2)(20x1) = 2.45$ inch. From Fig. 5 entering at 3 fps, rising to 2.45 inch (by interpolation of space between the 2 inch and 3 inch horizontals), following directrix line to base scale, rising to dashed horizontal for 75F, returning along directrix line to base scale; then read h = 320 Btu per hr per sq ft per F.

Corrections for flow normal to tube bundles and through baffled shell-and-tube exchangers will be covered in the next article.

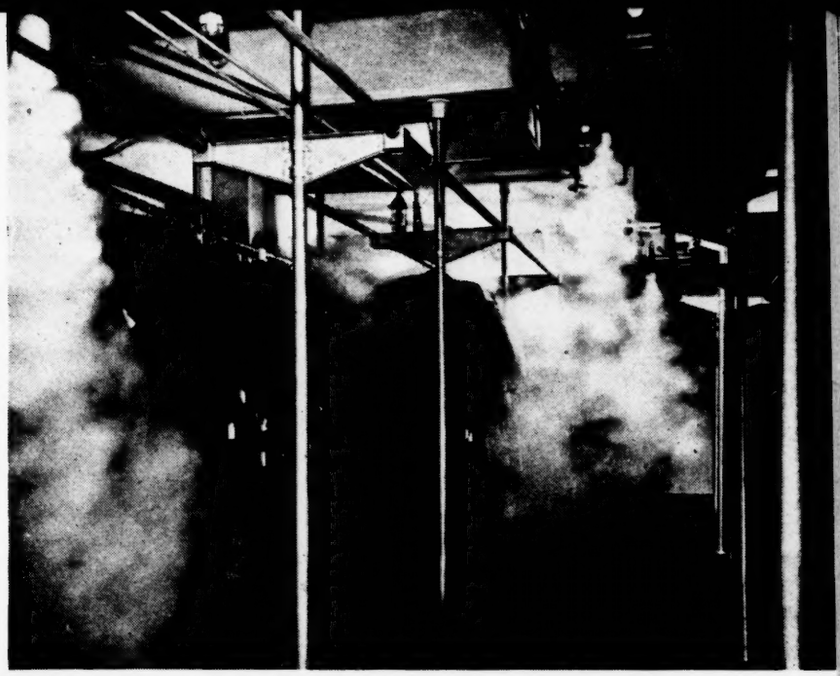
[1]Table 1 covering ASA-40 standard iron or steel pipe appeared in last month's issue.

60F for State Capitol – in 1847

Illinois lawmakers of 98 years ago would have called the current Federal recommended room temperature of 68F too hot.

The Illinois House of Representatives on Feb. 4, 1847, resolved that the temperature in their legislative chamber should be kept at 60F. The resolution said that the temperature was necessary for the good health of a "large and deliberative assembly," and because most House members were accustomed to strenuous exercise in the open air.

Picture Paragraphs



Furs are guarded against fire by a Walter Kidde & Co. system, which releases carbon dioxide gas and at the same time shuts off ventilating blowers and closes louvers between floors. The gas, which is stored under pressure, is released when heated air touches a special heat detector.

Pipe being fitted to an FP boat bulkhead at Wheeler Shipyards, Whitestone, N. Y. A new type of Dresser bulkhead seal has reduced the time for installing this piping. FP boats are 200 ft long and will carry freight and passengers. Each boat has 12 deck penetrations and 50 bulkhead penetrations. The bulkhead seal is essentially a stuffing box gland of steel with rubber compound gaskets.

Viso-Trainer developed by the Frigidaire Division, General Motors Corp., for demonstrating the proper methods of servicing the company's refrigeration equipment. Glass tubing represents the copper tubing used in the cooling unit. Function of various valves and action of refrigerants are easily demonstrated. Typical service problems and conditions are duplicated.

Making refrigerated cabinets at the plant of Mills Industries, Chicago, for the shipment of whole blood to the battle zones. Cabinets have a heating system, thermostatically controlled, when outside temperature would freeze the blood. Cabinets can be used in Arctic or tropical climates.

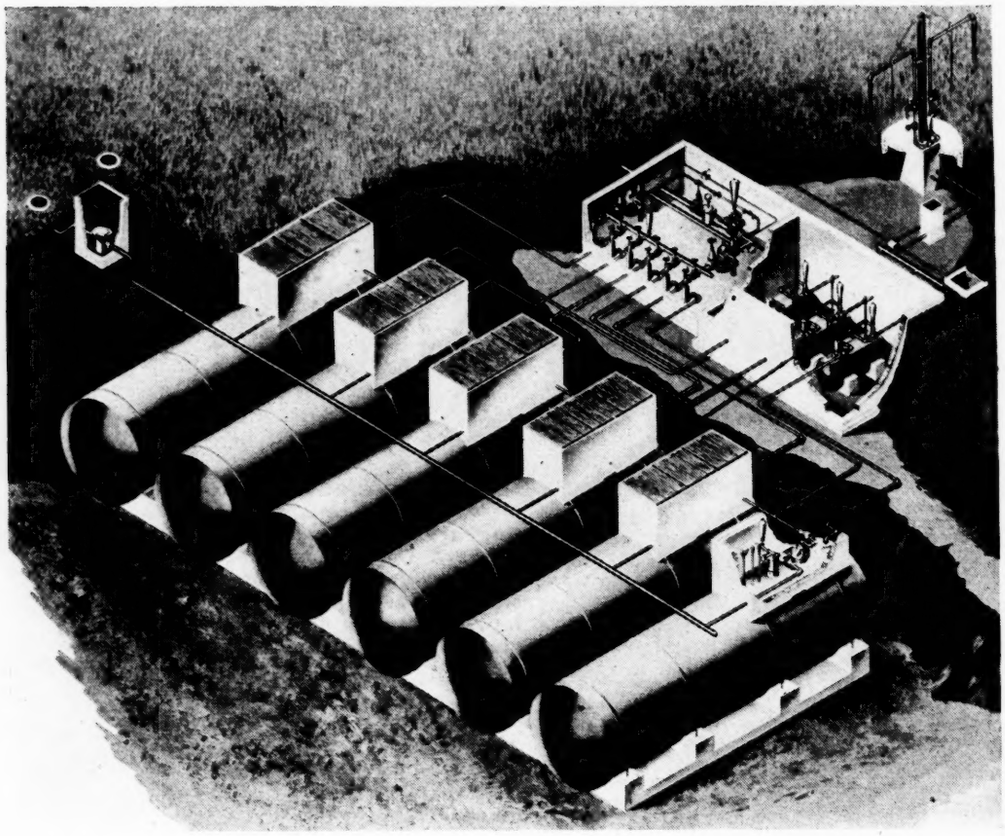


Fig. 3. Hydraulic delivery system for a battery of tanks operated from a common source of water pressure.

Gasoline Piping and Storage

HARRY D. UNWIN

Mechanical Engineer, Albert Kahn Associated Architects and Engineers, Inc.

PART 2

Hydraulic Delivery System. In contrast to the several types of pump distributing systems the hydraulic system, or flotation method, as it is often called, requires only water pressure for its operation. It is based on the principle that gasoline and water do not mix, as evidenced by the fact that accumulated moisture in vented tanks separates and collects in the bottom; therefore a greater amount of water in the storage tank is not detrimental to any gasolines whose several components are immiscible with water. This method has been successfully applied to large industrial systems to supply aviation test cells, airport fueling systems and various small service station and garage installations.

Fig. 3 illustrates the several parts of this type of system when a battery of tanks is operated from a common source of water pressure. There are seven distinct phases to a complete hydraulic system: (1) Unloading station which may be either by gravity or pump; (2) the storage tank with flow control valves on the fill and delivery connections; (3) safety or sediment trap; (4) float controlled delivery tanks at terminal delivery points; (5) water control

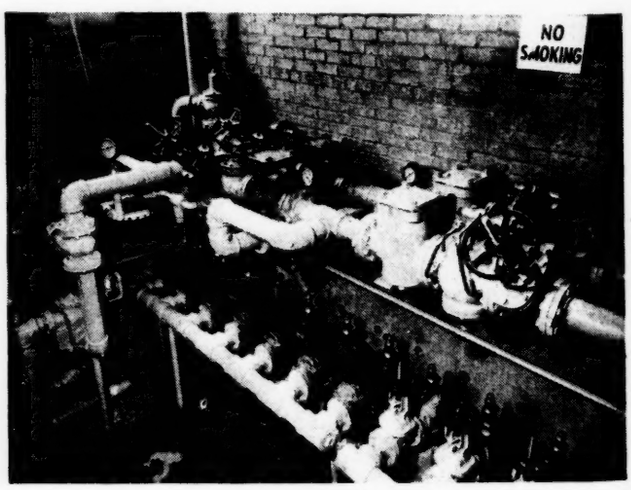


Fig. 4. Arrangement of valves and controls in a water control system.

Part of a Series of Articles on Process Piping in Industrial Plants

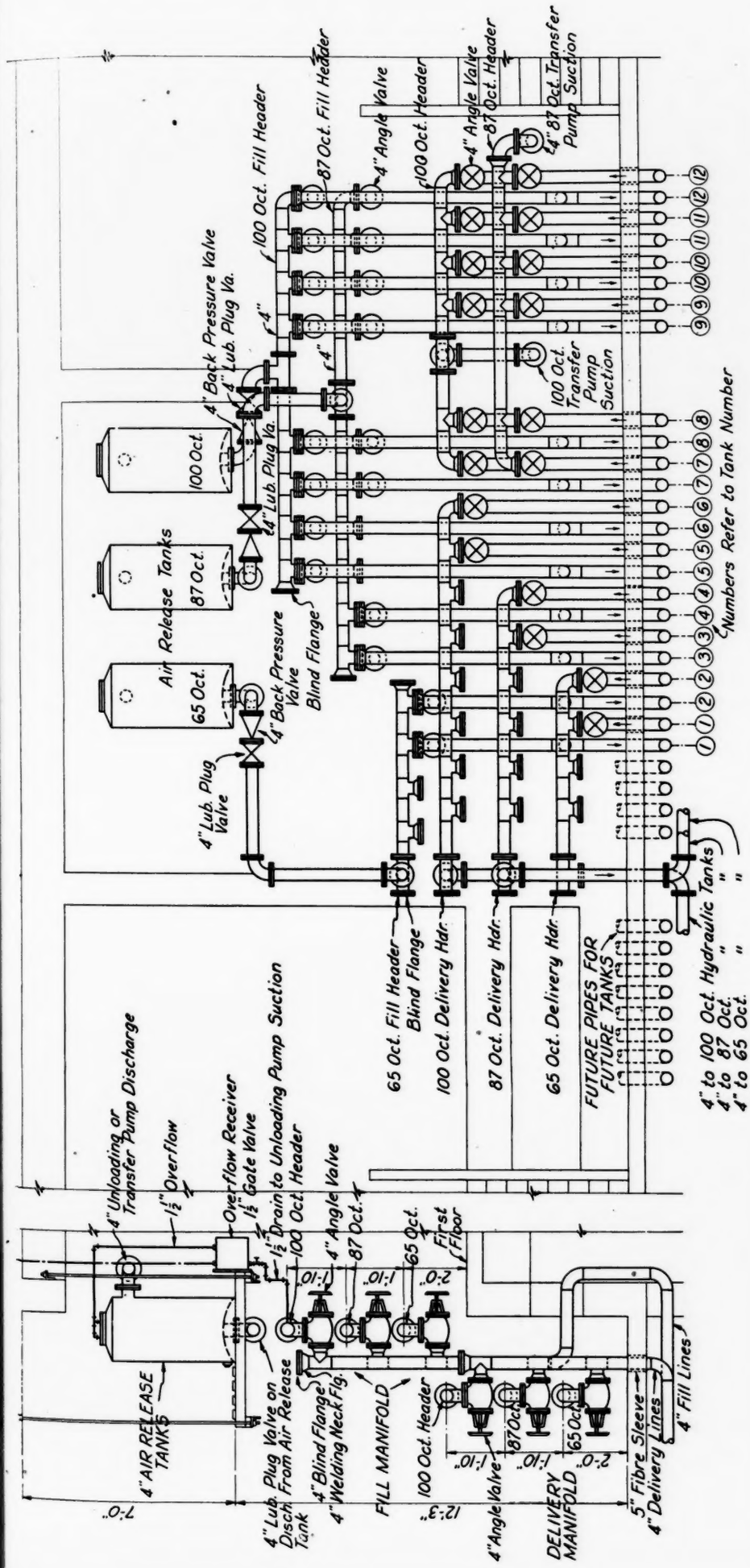


Fig. 5. Manifolding of storage tanks on a typical installation where vented tanks were used for bulk storage and the hydraulic system for gasoline delivery to the test cells of an aviation engine plant.

and delivery system to storage tanks; (6) sewer trap tanks; and (7) sump pump when required. As illustrated, the delivery of gasoline is to a truck loading station and airport fueling pits (not shown) and shows items (1) gravity unloading; (2) storage tanks; (3) sediment traps; and (5) water control system. A description of the function and operation of these several parts as applied to a system for a large aviation engine plant will best serve to indicate the advantages and disadvantages of the flotation method. With the exception of the float controlled delivery tanks, this description also applies to airport installations. For single storage tank installations for garages, and similar installations, the system is materially simplified.

Gasoline filling of the storage tank is accomplished by displacement of the water in the tank which passes through the water control valve to the drain. When the level of gasoline reaches a predetermined level a float valve closes the inlet valve. The water control valve is then turned, closing the drain port and opening the water supply line to the tank. Pressure is immediately placed on the tank and instantaneous delivery is available in the distribution system. A float controlled outlet is provided which closes the gasoline discharge valve when the level has reached a predetermined point beyond which there is danger of passing water into the distribution system. These gasoline inlet and outlet float operated valves compare to the

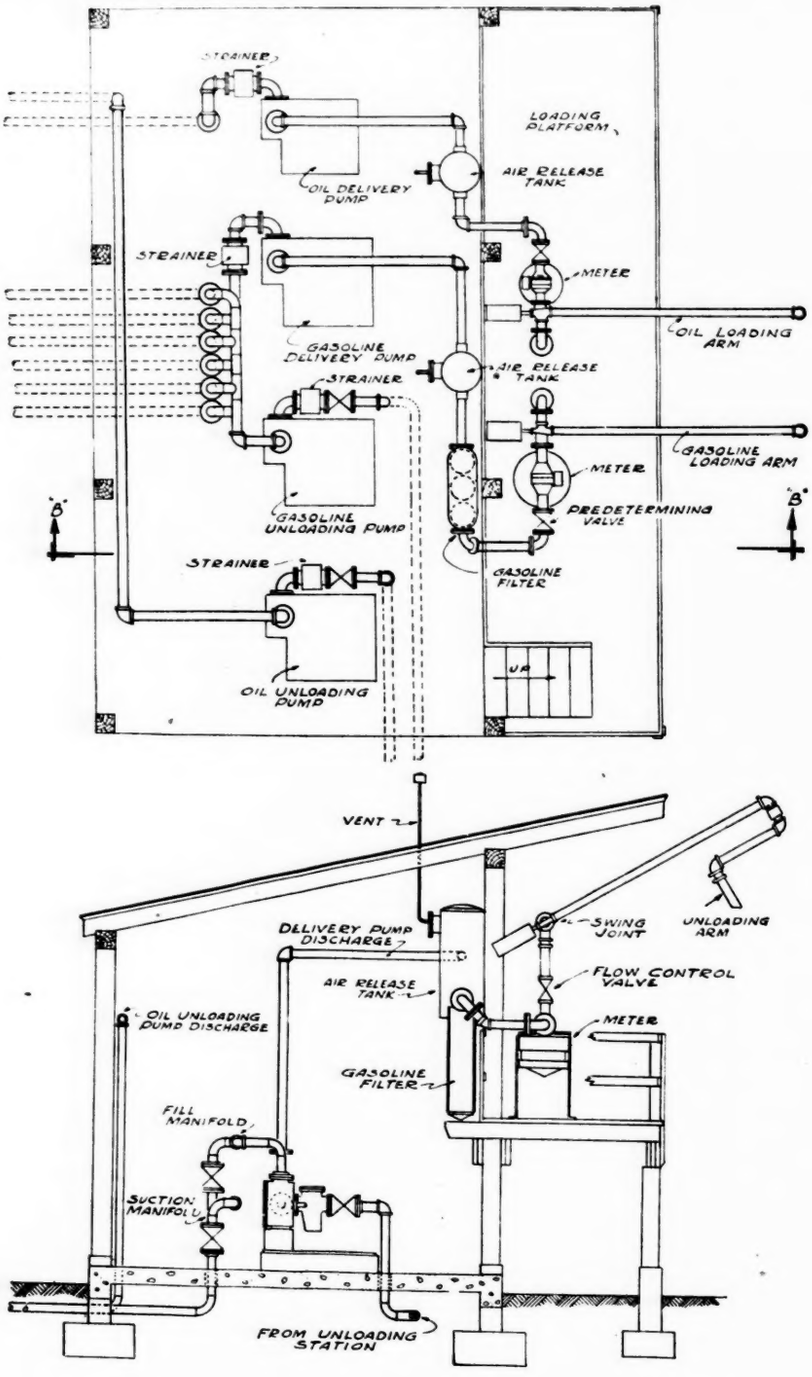


Fig. 6. Plan and sections of an above-ground gasoline and oil storage and truck loading system.

high and low level shutoffs frequently installed in the vented tanks except that the levels are controlled in reverse.

The source of water pressure is usually the available city main pressure which is reduced to about 20 lb per sq in by a pressure reducing valve. Higher pressures can be used depending upon the delivery head required. Fig. 4 shows a typical arrangement of the valves and controls in a water control system. There is a master system control and individual controls for each storage tank. In some localities approved vacuum breaker valves are permitted on the city water connection to the system to safeguard against possible back-syphonage due to water pressure failure. This is a common ordinance relating to all processes requiring direct connection to city supply mains. Other localities prefer a complete disassociation of the water supply by means of a definite gap between water supply and process equipment. In this case an elevated water tank is required to produce the same static head that would result from the use of a pressure reducing valve. Both methods have been used to advantage.

Since no mechanical equipment is failure-proof, even though such occurrences may not yet have occurred, it is a good investment to provide safety devices to protect any system which is as important as the distribution of gasoline. The safety trap and sewer trap protect against possible failure of outlet and inlet floats, respectively. The safety trap is a small tank with the same type of float control valve as the one installed on the storage tank delivery outlet. If the storage tank outlet valve should fail to close when the water level has risen to the "empty" level, water would then pass out into the safety trap and the second float control would have to fail also before water could get into the distribution system. The pollution of streams is recognized as a problem of major importance, and as a result, every effort is being made to prevent industrial wastes from entering storm sewers and drainage systems. For this reason the sewer trap tank is an excellent safeguard. It is provided with a float controlled inlet valve which closes if gasoline should pass the storage tank water connection due to failure of the fill control valve float during filling of the storage tank. The safety float valves do not act instantaneously, but when the level of the foreign liquid in the particular branch of the system has accumulated to the danger point.

From the safety traps, the gasoline is delivered to head tanks located in the test cell passageways. These elevated float operated vented tanks provide a constant delivery pressure to the gasoline for distribution through the various controls to the engine undergoing test. A handling system at an airport would deliver the gasoline from the safety traps to fueling pits consisting of steel boxes housing a meter, hose and controls for operating the hydraulic system. There are many styles and arrangements of these hose and meter pits both for hydraulic and pumping systems.

The hydraulic method of distribution has the ad-

vantages of eliminating venting losses and explosion hazards due to vapor space in the storage tanks. Suction lift is not required nor high speed pumps which in some cases tend to cause vaporization of aviation gasolines that are now being used which may range as high as 150 octane. On the other hand, where water conservation is a serious problem a large gasoline consumption may cause concern since the rate of gasoline consumption is equal to the demand on the water supply, gallon for gallon. Reservoirs could be provided to re-use the water but because of their size few if any have been installed.

Unloading Pump House. In any handling system where several grades of gasoline are handled simultaneously the principles outlined above remain unchanged, but the amount of equipment is increased. When interchangeability of products in different storage tanks is desired the system becomes more intricate. During the World War period when speed has been essential, lost time due to gasoline handling procedure has all but been eliminated by the manifolding of storage tanks so that any product could be stored in and delivered from any storage tank. Fig. 5 illustrates such a manifold where vented tanks were used for bulk storage and the hydraulic system for gasoline delivery to the test cells in an aviation engine plant. Such an arrangement can also be utilized in a positive displacement pump delivery system. The unloading pumps discharged the several grades of gasoline through air release tanks to the underground hydraulic or vented tanks. Transfer pumps of the rotary positive displacement type were used to draw out of the vented bulk storage tanks and deliver to the hydraulic tanks. With this manifold system the storage ratio of different types of gasoline could be changed as conditions warranted without any mechanical changes to the system being required. Since this manifold was located in the same building with the unloading pumps and hydraulic delivery system equipment, the operating crew was minimum and ease of control and regulation greatly increased the efficiency of the entire system.

Truck Loading Station. In some locations, soil conditions make the cost prohibitive to install underground storage tanks. Fig. 6 illustrates an aboveground gasoline and oil storage and truck loading system. In keeping with standard practice the tanks are enclosed in a dike which may be of earth or masonry. The safety shut-off valve on the tank outlet protects the contents in case of fire and breaking of the discharge line. This type system can be extended to include several loading arms for each product, such as would be required at a bulk storage plant.

In the third installment next month the author will present the theory of flow as it relates to gasoline, together with the complete solution of a problem.

Heating a Hill to Stop Earth Slides

An application of heat to dry out a cliff in Southern California to prevent earth slides is in successful operation near Los Angeles, and has resulted in the name Heated Hill being given to the locality. The heated hill is located in the Santa Monica Mountains and forms a part of the precipitous bluffs which extend along the Pacific Ocean, north of the city of Santa Monica.

A gas-fueled plant has been installed to provide heated air with which the interior of the cliff literally is being dehydrated by having its water content removed in order to stop dangerous slides along the seaward side.

The top of the bluff is occupied by a half million dollar mansion built by the late Mary V. McCormick, daughter of the harvester king. The structure is now used as a merchant marine rest center. The gardens extend to the edge of the cliff which drops abruptly 200 feet to the Coast Highway along the sea shore.

When the edges of the cliff began to crumble and indicated a possibility of continuing until the house was in danger, engineers were called in to recommend a method for stopping the land slides. Surveys disclosed the cliff to be composed of layers of clay into which water seeped from above, causing the edges of the bluff to crumble and eventually break off. The engineers suggested a daring plan for removing the moisture which, they claimed, would dry out the cliff with heat sufficiently to prevent further crumbling.

As ultimately carried out, the plan includes a 1200 foot tunnel driven parallel with the cliff's face and about 90 feet back from the edge. Drain pipes, spaced at about 50 foot intervals, extend from the horizontal tunnel to the edge of the cliff to carry off any water that may enter the tunnel.

To dry out the moisture in the clay, an installation consisting of a gas-fired furnace and a blower is being used with success. The furnace and fan are set up at the mouth of the shaft, their function being to provide heated air for propulsion into the tunnel by the blower.

A gas furnace designed to meet the novel needs of the enterprise has been installed. It is constructed of brick. Firing equipment consists of three Nemic upshot burners. Operation is controlled by thermostats. The furnace supplies 160 to 175F air which is blown into the tunnel by the fan mounted to the rear of the furnace. The installation is reported to have eliminated entirely the danger of earth slides.

Nomograph for Determining Humidity

MELVIN NORD and S. F. CIRICILLO

Perhaps the principal disadvantage of the conventional psychrometric charts is that so much data are shown that reference to them is somewhat complex for the occasional user. The accompanying chart, since it gives only specific and relative humidity, is advantageous when only these data are required; it is practically impossible not to use the chart correctly.

THE accompanying simple nomograph will often be found convenient for solving certain problems where the conventional psychrometric chart with its numerous variables is hardly necessary. The purpose of the graph is to determine the relative and specific humidities when the wet and dry bulb temperatures of the air are known. To use the chart, locate the dry bulb temperature on the left scale, the wet bulb on the right scale, connect the two with a straight line, and find the relative and specific humidities at the intersection of the line with the curved scales.

For example, the dotted line shows that for t_d = 80F and t_w = 70F, the specific humidity is 94 grains per pound of dry air and the relative humidity is 61%.

The construction of the nomograph is based on the equation:

$$\frac{H_w - H}{t - t_w} = \frac{s}{r_w}$$

Where H is the specific humidity at the dry-bulb temperature, t; H_w is the humidity at the wet-bulb temperature, t_w; s is the humid heat at the temperature, t; and r_w is the latent heat of vaporization of water at temperature t_w.

This equation can be written as:

$$H_w + \frac{st_w}{r_w} = H + \frac{st}{r_w}$$

which indicates that a linear relation between humidities can be obtained by using the new variable:

$$f(t) = \frac{st}{r_w}$$

Since, in practice, t is not usually far from t_w, and furthermore s and r_w do not vary rapidly with temperature, it is possible to say with sufficient accuracy

$$f(t) = \frac{st}{r}$$

and

$$f(t_w) = \frac{s_w t_w}{r_w}$$

If we now plot f (t) against f (t_w) on linear scales, the specific humidity is determined. This is done empirically; that is f (t) is marked off upwards and f (t_w) downwards on equal linear scales, and values of specific humidity from a psychrometric chart are located. Since the relative humidity, for a given dry-bulb temperature, is directly proportional to the specific humidity, the same linear scales of f (t) and f (t_w) also determine the points for relative humidity.

Thus, specific humidity and relative humidity are plotted against f (t) and f (t_w), the latter two scales being calibrated directly in terms of dry- and wet-bulb temperatures, on a non-linear scale.

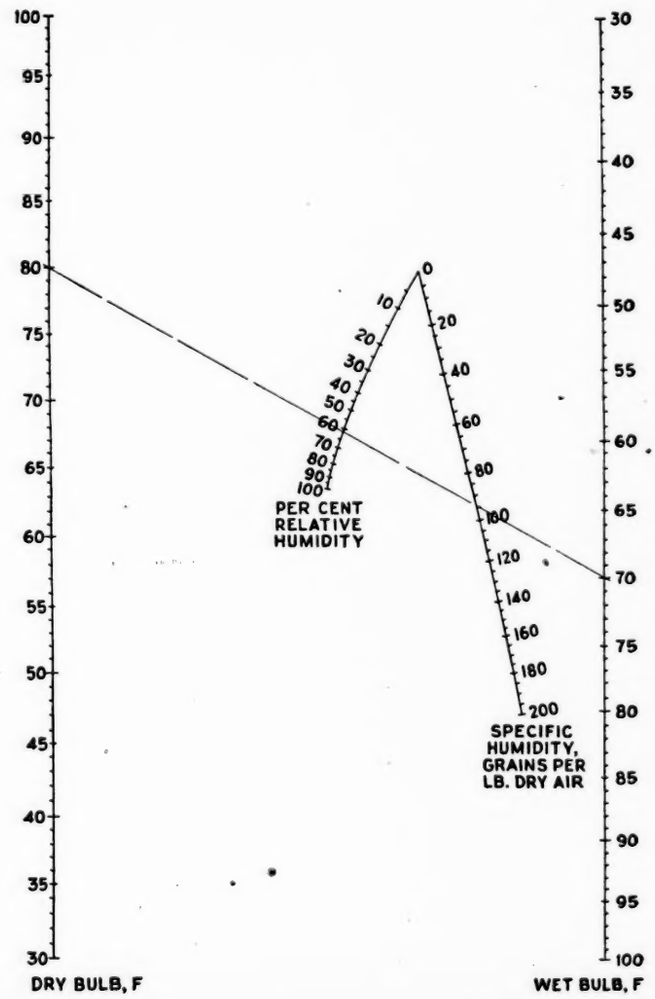
For low ranges of temperature, such as occur in air-conditioning, we can say:

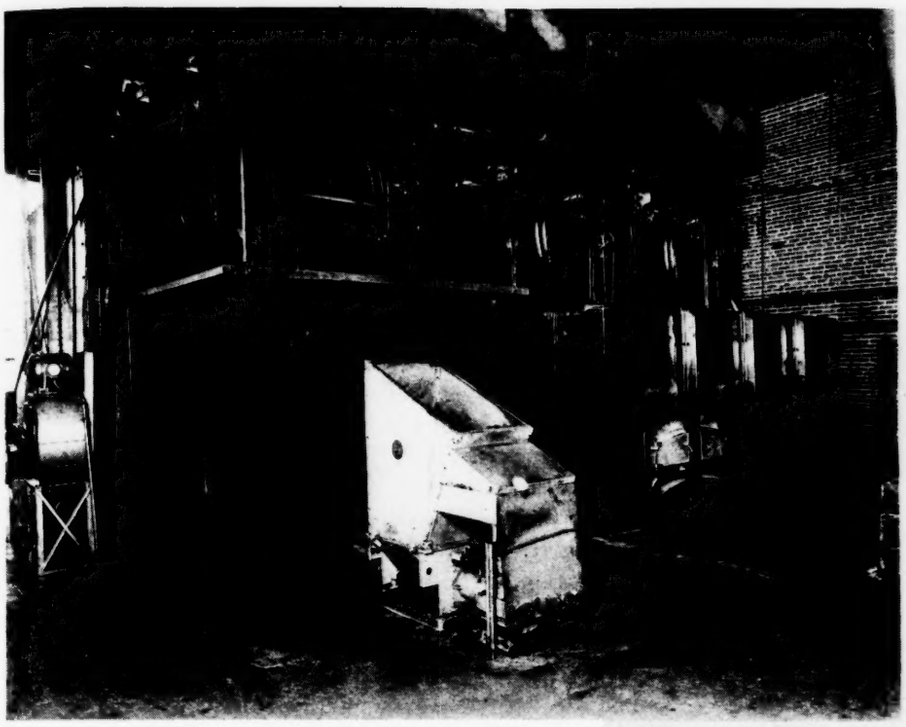
$$s = 0.231 + .000283t$$

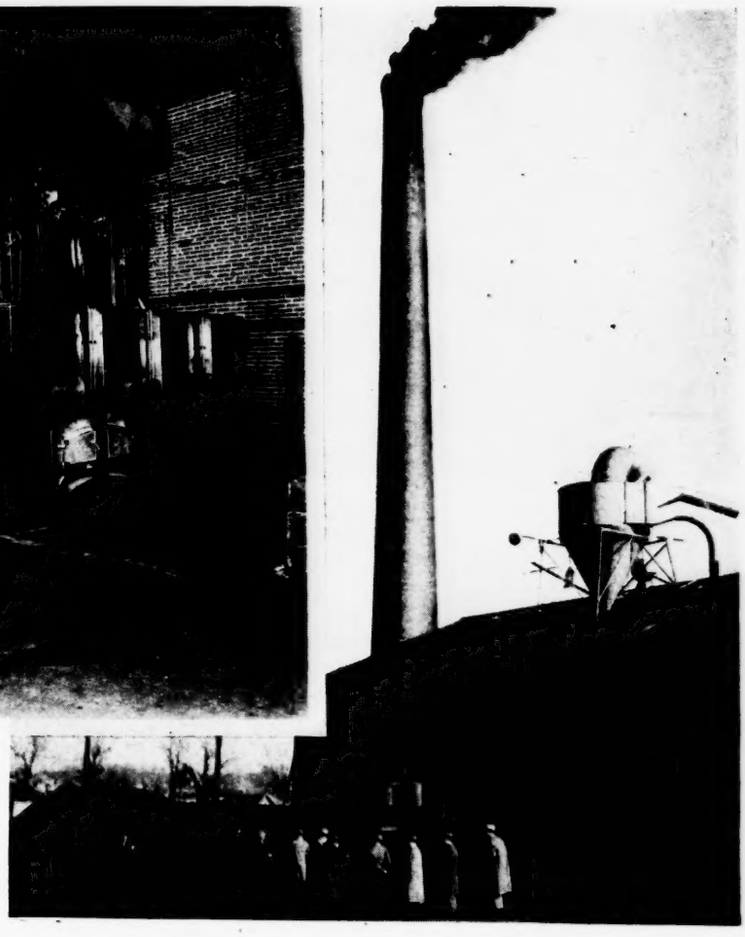
and

$$r = 1094 - 0.57t$$

Thus f (t) is determined in terms of t, and the nomograph is plotted.







Above—two hand-fired boilers to which over-fire application was made. Right—smoke condition at the plant of the Continental Gin Co., Birmingham, Ala., before installation of the over-fire device.

Over-Fire Air System Eliminates Smoke

GEORGE H. WATSON

SMOKE has been eliminated and combustion improved in several Birmingham, Ala., heating plants by the injection of air over the fuel beds, according to T. W. Lankford, city smoke abatement inspector.

Installations, made to comply with the city's anti-smoke ordinance and in cooperation with the Alabama Mining Institute, have included power plants serving laundries, lumber and working plants, hospitals and various manufacturing establishments. The smoke inspector has conducted groups of engineers to these installations to observe the principle of over-fire injection in operation and similar installations in other heating plants, including those in apartment houses, hotels, and other commercial establishments.

One of the larger installations is for Continental Gin Company, cotton gin and diesel engine manufacturers, now largely engaged in wartime ordnance production. The company's own engineers designed and made the installation. The power plant includes three 150 hp HRT boilers, one of which is stoker-fired. A blower installation to provide over-fire air was made for each of the two hand-fired boilers. These fans of the company's own design and manufacture, have capacities of 400 CFM at 10 in. static pressure.

The blowers discharge preheated air into a multiple nozzled manifold installed in the bridge wall. The nozzles, with 1⅛ in. tips, are uniformly spaced across the furnace approximately 18 in. above the grate line. There are eight nozzles to each boiler. The high velocity delivery through these nozzles is directed against the flow of the normal furnace gas and toward the feed door.

The quantity of air injected over the fuel bed is small in proportion to the total volume of the furnace gases, but at its exceedingly high velocity cuts through the strong updraft prevalent within the fire chamber at high temperatures. This produces a turbulence over the fire-bed which prevents stratification and allows a complete supply of oxygen to come in contact with the burning gases. This turbulence, in addition, breaks up the CO_2 gas which tends to

T. W. Lankford, city smoke abatement inspector, Birmingham, discusses over-fire application with engineer (right) of the Continental Gin Co.

blanket partially consumed combustible gases. As a result, oxygen is supplied for complete consumption of the combustibles and smoke is eliminated.

Volume of air injected is held not to be so important so long as high velocity and penetration are attained, since in most furnaces there is plenty of air for combustion anyway if it can just be mixed thoroughly. The quantity of air is regulated by a damper on the intake side of the fan with a balance being reached between a non-smoking stack and as high CO_2 as possible.

The blower units have automatic electric controls, which function when a boiler door is opened to fire the furnace and cut off with a time-relay three minutes after the furnace door is closed. The time is ample to allow for complete combustion of the excessive volatiles released from the charge of green fuel fired.

The air preheater for this installation consists of a jacket around the boiler breeching which supplies air at a temperature of 250F to the suction of the blower units. In other Birmingham installations air at boiler room temperature is used and no effort is made to pre-heat it. Engineers question whether the small increase in efficiency of the pre-heated air is worth the added expense involved, especially as there is some pre-heating of the air by conduction as it passes through the hot bridge wall manifold.

While coal is used as a fuel in this plant, the over-fire air application has been successfully applied in Birmingham to HRT boilers using plane shavings, sawdust, and other mill refuse as fuel. Also, the Louisville & Nashville Railroad recently eliminated smoke from several of its coal-burning locomotives by installing the over-fire air jets.

Over-fire air can be introduced by high-pressure steam as well as by fans, but on the basis of operating costs the fans are cheaper. However, there might be cases where steam jets are justified because fans are not available, where their cost would be prohibitive, or where turbulence only is needed and additional air would be detrimental to furnace performance.

Engineers point out that while over-fire air can correct many deficiences, it is not a cure-all for smoke caused by extremely poor firing practice or equipment. To use where careful attention to operation or equipment would do as well, would be a waste of steam or power. Also, where an over-fire air system is installed, it should be operated only as needed, usually for two or three minutes after adding fresh fuel.

Floating Cold Storage Plants for Army

Now there'll be plenty of ice cream for American soldiers stationed on U. S.-occupied islands in the South Pacific. In addition, these troops will have their first taste of fresh meats, fruits and vegetables in many months brought to them by a new type barge. Built at National City, Calif., the barges, of which there are only three in the world, are operated by the Army Transportation Corps and cost $1,120,000 each. They are known as BRLs (Barge, Refrigerated, Large), and have a special unit which turns out 10 gallons of ice cream every seven minutes and a plant which manufactures five tons of ice a day.

The equivalent of 64 carloads of frozen meats can be stored in the barges' eight main holds at 12F. Two main deck compartments each have a capacity of about 500 measurement tons of fresh vegetables, cheese, eggs and other perishable produce. Eighty-four electric motors with capacities up to 150 hp, care for the barges' elaborate cooling machinery and for the 12 blowers which provide a complete change of arctic air every four minutes to all chill and freeze compartments.

A feature of the floating refrigerators is the overhead monorail conveyor system which can load, discharge or shift cargo in two-ton drafts to or from any hold. The barges have flat-bottomed concrete hulls, are 265 ft long with a 48 ft beam and 12 to 15 ft draft. They carry a crew of ten officers and 13 men.

The barges will operate solely in the Southwest and Western Pacific as floating chill-freeze warehouses. Transportation Corps-operated small boats, used almost exclusively for inter-island service, will pick up the cargo from the barges and will deliver it to the troops.

WASHINGTON NEWS

Production of Civilian Goods Delayed; Freon Users May Appeal Order; Unit Heater Delivery Frozen.

Summarized by LORING F. OVERMAN

There is hope in unofficial Washington that the recent swing of the production pendulum from conversion planning to armament delivery may have reached its extreme even before the various agencies involved have time to issue all of the directives, edicts and legislation contemplated as necessary to offset the effects of military reversals in Europe.

Not that there is any official justification for such an interpretation. On the contrary, each day finds some new prohibition announced; some hitherto unsuspected shortage imminent; some new evidence uncovered to disprove pre-election claims that the war machine ever had enough of anything.

Thus, official Washington is in somewhat the same position as a football team, holding the ball and a 3-point lead in the closing minutes of play. With its eye on war's stopwatch, it is reeling off the plays called for by the quarterback, but sincerely hoping it will soon hear the final gun that will put a stop to what seems like back-pedalling.

In the meantime, however, it appears that no stone is being left unturned to rectify the pre-Christmas error of preparing to leave the stands before the game was actually over.

A-C IAC Gets Facts

Typical of what industry is finding out about war needs was the data given members of the General Refrigeration and Air Conditioning Industry Advisory Committee at their last meeting in Washington on January 10th.

"Forget civilian production until the European war actually ends," members of the committee were told. Backing the admonition were facts and figures on manpower needs, transportation difficulties, component part famines, static fuel production and skyrocketing requirements, and so on, ad infinitum. Specifically, members were reminded that civilian production of plumbing, heating and air-conditioning equipment during the first quarter of 1945 would be held to the same levels as during the fourth quarter of 1944; that no new "spot authorization" permits would be issued to start production in areas not loaded with war production, and that some spot programs might be curtailed if present manpower shortages continue.

By the time committee members gather in Washington for their next meeting, on February 14th, W.P.B. will no doubt have issued an order placing condensing units up to 2 H-P on an authorization basis similar to that employed in producing and allocating fractional horsepower motors. Under this plan, those needing units would file applications for quarterly needs, together with an inventory of units on hand. W.P.B. would give such applications the once-over, squeeze out any apparent "watering," deduct inventory on hand, and allow the applicant to receive a specified number.

Freon Order Changes Due

Also in the offing is another amendment to W.B.P. Order No. M-28. Details are to be discussed at the Industry Advisory Committee meeting, but it is understood there will be no modification of present prohibitions against delivery of Freon to certain restricted types of comfort air conditioning.

A reading of the present order reveals, however, that any user of air conditioning equipment who is subjected to unreasonable hardship because of the prohibition against deliveries of specified refrigerants is permitted to file an appeal requesting that individual consideration be given. This being the normal slack season in the refrigerant-using fields, it is logical to assume that appeals filed in mid-winter will be accorded more careful consideration than during a time of actual shortage—particularly if the appellant is in a position to install any refrigerant that might be granted immediately, without tying up storage facilities. The appeals paragraph of Order M-28 reads as follows:

"Any appeal from the provisions of this order, or from any direction thereunder, shall be made by filing a letter in triplicate, referring to the particular provision appealed from and stating fully the grounds for the appeal. All reports to be filed or other communications concerning this order should be addressed to: War Production Board, General Industrial Equipment Division, Washington 25, D. C., Ref.: M-28."

Could Be

Recent conversations around Washington concerning a rumored happening in the Freon field indicate that those needing and able to install the refrigerant at once may be missing a bet if they fail to file appeals. The rumor is that when a temporary surplus of Freon appeared likely, it was also pointed out that if the surplus were stored for future use, large numbers of cylinders needed for current handling would be tied up. As a result, some of the components destined to have been converted into Freon were used in the manufacture of carbon tetrachloride, a cleaning fluid of which there is also a shortage.

This correspondent observes that if W.P.B. had had on file enough appeals to have absorbed the immediate surplus without unduly tying up cylinders, a considerable number of A-C systems now empty might have been filled and awaiting the return of summer temperatures. Although such a situation may not occur again this season, it would seem that there is everything to gain and nothing to lose by filing appeals requesting delivery when, if, and as the refrigerant becomes available, and promising the immediate return of the required cylinders.

The cylinder supply now appears to be the determining factor insofar as Freon supplies are concerned. Unless deliveries can be made now to less essential users, it seems apparent that when warm weather arrives, the essential group will again claim all of the facilities available for the storage and delivery of Freon.

Unit Heaters Frozen

Delivery of unit heaters for extended surface heating will be limited to orders with ratings of AA-2X or better during the 90-day period from January 16 to April 16, the War Production Board has announced.

The 90-day freeze on deliveries of orders rated lower than AA-2X has been ordered to permit manufacturers to catch up with the large backlog of orders classified as essential to the war effort. There is no inventory of unit heaters at present, and the lack of copper and steel for use during the third and fourth quarters of 1944 and

the first quarter of 1945 has made it impossible to meet the demand, the W.P.B. explains.

The wording of W.P.B.'s explanation —lack of copper and steel—explodes another of the bubbles of surplus so noticeable prior to the Von Rundstedt break-through. Most manufacturers had understood that any reconversion plans for 1945 would not be hampered by lack of metals, of which it was claimed there was a surplus in most categories. Any possible slowdown, it was explained, would be due almost solely to shortage of manpower.

Now it appears that the manpower tail is wagging the metals dog. In fact, this is happening to such an extent that the short tail is threatening even further shortages of critical metals. For example:

'Round and 'Round

While the petroleum industry's problems are only indirectly those of the Heating, Ventilating and Air-Conditioning industries, Mr. Davies' comments are cited as illustrating the endless ramifications of the supply and shortage problems. At the base of the Surplus foundation a trickle of manpower shortage appears. Strengthened by the current Selective Service drive on 26-29-year-olds and farm-deferees, War Manpower Commission's employment ceiling and labor lend-lease system, and Congress' 4F roundup, the trickle reaches flood proportions. Suddenly industry wakes up to find that what it had assumed was a spot shortage has encompassed everything animal, vegetable and mineral.

Lead, for instance, is subjected to new restrictions in an amendment to Order M-38. Previous restrictions, announced December 27th, had cut civilian use of lead to 60 per cent of 1944 levels. Among new restrictions:

One eliminates use of lead in gutters and leaders on all dwellings. Formerly dwellings over three stories were exempt.

Another prohibits use of lead sheet, pipe (including lead-lined pipe), fittings and burning bars except for military uses and where municipality and State regulations permit no substitutes for lead. Use of lead for repairing of existing plumbing lines is permitted.

Brass and cadmium also continue among the short items, with no relaxation in present restrictions contemplated.

Building Tide Low

More directly reflecting the Heating, Ventilating and Air-Conditioning field's outlook for the year is the latest estimate of new construction volume for 1945. Based on the assumption that war on both fronts will continue throughout the year, forecasts indicate an activity volume of $3,250,000,000, W.P.B. announced on January 15. This is the lowest volume forecast since 1935.

This estimated activity is 82 percent of the 1944 volume and 24 per cent of the peak 1942 performance. Almost half of the 1945 volume will be accounted for by privately-financed work, as contrasted to 40 percent in 1944 and 20 percent in 1942 and 1943.

Construction activity generated by purely military requirements is expected to be about a third less in 1945 than in 1944, both for industrial and non-industrial work. Activity in the categories for essential civilian and indirect war purposes is expected to continue in 1945 at about the 1944 rate, with an estimated decline in new housing volume being offset by increased non-military work in the industrial field and other non-residential categories.

Delivery of processing machinery and equipment to industrial plants in 1945 will be down an estimated 75 percent of the 1944 rate and will have a total value of $1,150,000,000. Of this amount, $650,000,000 represents the estimated volume of deliveries to Government-financed plants.

Post-War Index

Although the 1945 construction outlook offers little to enthuse readers of HEATING AND VENTILATING, two recent housing transactions announced at Washington serve to indicate the post-war trend. Subject to the availability of building materials, 30,000 temporary dwellings are to be built in this country and shipped to England's bombed out areas, while barracks for 150,000 workers repairing dock areas are to be sold to the French provisional government. While all will be of the simplest construction, sans A-C, the transactions serve to illustrate a world-wide construction need that will, after the war, be shared by designers and producers of heating and air conditioning at its best.

Temperature Control

Whether because of an actually threatened coal shortage, or perhaps a desire to build a stockpile as a bulwark against the annual March expiration date of coal miners' contracts, Washington certainly has its eye on the coal bucket these days.

Assistant President Byrnes urges temperatures of 70 degrees or less.

W.P.B. expects to save 2,000,000 tons of coal by "browning out" electrical displays.

P.A.W. Ickes directed Indiana coal mines to cut January shipments to industrial consumers having more than 20 days' supply on hand.

Wartime measures for replenishing the Great Lakes coal docks with next winter's fuel supplies during the 1945 navigation season were announced on January 24th. The regulation is designed to effect a more equitable distribution of available hard fuel.

Meanwhile, W.P.B. keeps up its fuel conservation publicity campaign, keyed to the theme that fortunate is the individual who has found that it is cheaper to be comfortable with an insulated, weatherstripped, storm-windowed, thermostat controlled system than to be chilly with one that eats coal like paper and lets the resultant heat escape.

Oil, Too—

Users of oil equipment are also being watched, with a speeding up of tank car turn-arounds and a new system of inventory reserves announced January 24th for industrial users. The new inventory regulations, embodied in Amendment 43 to Revised Ration Order 11, Fuel Oil, revises the method of figuring inventory reserves and includes a procedure for withdrawing reserve allowances.

In all instances where industrial consumers request inventory reserves —now to be figured in an amount up to the applicant's total storage capacity used for the regular ration —the Petroleum Administration for War will decide whether or not the local supply is sufficient to permit the reserve. In the matter of downward adjustments, reserves will be withdrawn whenever the O.P.A. district director or the Petroleum Administration for War deems such action necessary.

The new provision will affect consumers who have fuel oil rations for commercial, industrial and governmental purposes—that is, for non-heating purposes such as the operation of manufacturing plants and public utilities. These consumers chiefly use heavy industrial types of oil, and are issued their required allotments every three months.

Announcement of the inventory reserve for non-heating uses follows similar action, taken January 15, providing in effect that consumers in the East Coast States who use fuel oil in other than private dwellings may not accept delivery of additional fuel oil if their tanks already store a supply large enough to satisfy normal seasonal withdrawals during the ensuing 10-day period.

The amendment does not affect fuel oil supplies in private dwellings, refineries, or bulk terminals. It permits public utilities to maintain a 30-day inventory.

Degree-Days for December, 1944

HEATING AND VENTILATING'S 18TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

CITY	DECEMBER			CUMULATIVE, SEPTEMBER 1 TO DECEMBER 31			HEATING SEASON[1]
	1944	1943	NORMAL	1944	1943	NORMAL	NORMAL
Abilene, Texas	689	673	592	1055	1053	925	2061
Albany, New York	1277	1297	1147	2624	2824	2439	6580
Albuquerque, New Mexico	888	1020	924	1769	1908	2751	4298
Alpena, Michigan	1298	1262	1247	2844	3047	2951	8299*
Anaconda, Montana	1331	1249	1238	3133	2959	3171	8357**
Asheville, North Carolina	904	800	837	1789	1839	1689	4232
Atlanta, Georgia	754	644	639	1314	1248	1131	2890
Atlantic City, New Jersey	925	898	893	1765	1798	1735	5176
Augusta, Georgia	643	527	549	1041	967	886	2161
Baker, Oregon	1173	1078	1156	2639	2502	2815	7163
Baltimore, Maryland	936	863	874	1724	1726	1664	4533
Billings, Montana	1189	1021	1194	2611	2334	2816	7119
Binghamton, New York	1233	1317	1156	2607	2842	2515	6808
Birmingham, Alabama	681	679	595	1160	1359	913	2352
Bismarck, North Dakota	1464	1254	1553	3315	2944	3514	9192
Block Island, Rhode Island	955	990	884	1940	1975	1736	5788
Boise, Idaho	1114	996	1011	2252	2154	2285	5552
Boston, Massachusetts	1062	1097	1026	2172	2220	2130	6045
Bozeman, Montana	1357	1282	1293	3076	2978	3286	8521**
Buffalo, New York	1228	1188	1104	2509	2718	2372	6822
Burlington, Vermont	1410	1424	1287	2994	3083	2773	7514
Butte, Montana	1394	1350	1261	3329	3239	3183	8272
Cairo, Illinois	967	896	822	1602	1707	1499	3909
Canton, New York	1489	1472	1342	3134	3215	2994	8020
Charles City, Iowa	1461	1263	1390	2811	3024	2895	7588
Charleston, South Carolina	577	467	425	870	805	632	1769
Charlotte, North Carolina	787	655	679	1394	1273	1220	3120
Chattanooga, Tennessee	825	768	694	1526	1567	1225	3118
Cheyenne, Wyoming	1171	1092	1144	2760	2717	2889	7466
Chicago, Illinois	1336	1163	1119	2406	2556	1919	5957
Cincinnati, Ohio	1110	1022	927	2053	2078	1796	4684
Cleveland, Ohio	1167	1081	1060	2249	2353	2185	6155
Columbia, Missouri	1171	1103	985	1987	2171	1896	4922
Columbia, South Carolina	682	572	561	1119	1044	916	2364
Columbus, Ohio	1155	1066	1017	2160	2200	2020	5398
Concord, New Hampshire	1329	1363	1234	2888	2941	2732	7353
Concordia, Kansas	1099	1087	1050	2007	2215	2019	5315
Dallas, Texas	648	633	567	937	1034	870	2256
Davenport, Iowa	1327	1140	1175	2354	2476	2333	6289
Dayton, Ohio	1219	1125	1014	2300	2387	1947	5264
Denver, Colorado	1001	927	1017	2082	2044	2276	5874
Des Moines, Iowa	1344	1165	1215	2396	2579	2370	6384
Detroit, Michigan	1250	1165	1113	2405	2587	2332	6490
Devils Lake, North Dakota	1602	1430	1710	3545	3414	3871	9970
Dodge City, Kansas	1042	1143	1004	1951	2170	1952	5035
Dubuque, Iowa	1377	1175	1243	2564	2694	2534	6790
Duluth, Minnesota	1545	1455	1519	3304	3573	3489	9443
Eastport, Maine	1209	1351	1228	2745	2916	2890	8520**
Elkins, West Virginia	1147	1070	1035	2488	2529	2217	5697
El Paso, Texas	629	664	617	1090	1151	1038	2428
Ely, Nevada	1226	1173	—	3050	2773	—	—
Erie, Pennsylvania	1124	1106	1039	2117	2432	2164	6273
Escanaba, Michigan	1390	1299	1344	2983	3170	3138	8771*
Evansville, Indiana	1084	1013	862	1936	2049	1545	4244
Fort Smith, Arkansas	835	779	707	1255	1371	1177	3147
Fort Wayne, Indiana	1334	1197	1138	2578	2692	2211	5925
Fort Worth, Texas	647	636	574	931	1009	826	2148
Fresno, California	543	536	577	970	971	911	2334
Galveston, Texas	308	334	270	422	518	330	1016
Grand Junction, Colorado	1016	967	1162	1935	1948	2278	5548
Grand Rapids, Michigan	1219	1155	1147	2430	2606	2397	6535
Green Bay, Wisconsin	1426	1283	1324	2825	3051	2882	7825
Greensboro, North Carolina	912	799	760	1727	1678	1395	3529
Greenville, South Carolina	796	658	738	1417	1315	1334	3380
Harrisburg, Pennsylvania	1097	1011	992	2137	2176	1981	5375
Hartford, Connecticut	1186	1183	1060	2444	2469	2157	6036
Hatteras, North Carolina	644	597	493	1045	1020	727	2571
Havre, Montana	1396	1141	1383	3198	2706	3314	8700
Helena, Montana	1526	1293	1245	3326	3031	3058	7898
Houston, Texas	380	371	335	535	607	449	1157
Huron, South Dakota	1358	1256	1431	2919	2909	3085	8004
Indianapolis, Indiana	1178	1066	1017	2129	2229	2002	5298
Jackson, Mississippi	594	—	—	935	—	—	—
Kansas City, Missouri	1142	1069	1008	1866	2110	1866	4956
Kewanee, Illinois	1285	1202	1118	2270	2666	2311	6139
Knoxville, Tennessee	863	782	781	1627	1632	1483	3670
La Crosse, Wisconsin	1384	1325	1311	2636	3112	2778	7322
Lander, Wyoming	1678	1384	1419	3637	3038	3075	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, Box 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

(a) Data not available.

[Table concluded on page 98]

Degree-Days for December, 1944 (Concluded)

HEATING AND VENTILATING'S 18TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

CITY	DECEMBER			CUMULATIVE, SEPTEMBER 1 TO DECEMBER 31			HEATING SEASON[1]
	1944	1943	NORMAL	1944	1943	NORMAL	NORMAL
Lansing, Michigan	1335	1231	1209	2757	2893	2665	7048
Lewiston, Maine	1343	1494	1295	2920	3154	2837	7707
Lincoln, Nebraska	1194	1093	1132	2225	2360	2201	5999
Little Rock, Arkansas	834	759	651	1297	1359	1079	2811
Livingston, Montana	1233	1080	1117	2924	2479	2731	7205
Los Angeles, California	164	255	301	385	356	424	1504
Louisville, Kentucky	1023	928	849	1805	1841	1587	4180
Lynchburg, Virginia	973	778	800	1878	1593	1557	3980
Macon, Georgia	615	565	567	1059	1084	897	2201
Madison, Wisconsin	1436	1253	1321	2724	2910	2758	7429
Marquette, Michigan	1347	1287	1302	2930	3155	3054	8693*
Memphis, Tennessee	845	755	663	1389	1443	1127	2950
Meridian, Mississippi	612	574	549	1030	1114	883	2160
Milwaukee, Wisconsin	1403	1238	1221	2624	2859	2601	7245
Minneapolis, Minnesota	1417	1287	1404	2801	3069	2941	7850
Modena, Utah	1108	1083	1168	2533	2394	2672	6562
Montgomery, Alabama	504	511	496	826	958	769	1884
Nantucket, Massachusetts	928	987	905	1913	1970	1912	5957
Nashville, Tennessee	896	816	744	1599	1613	1363	3507
New Haven, Connecticut	1101	1111	1017	2261	2320	2109	5895
New Orleans, Louisiana	314	349	301	441	608	403	1024
New York, New York	1010	1008	955	1899	1997	1849	5347
†Nome, Alaska	1492	1269	1509	3322	3073	3379	14580**
Norfolk, Virginia	779	691	685	1335	1290	1195	3350
North Head, Washington	608	594	654	1570	1538	1785	5452**
North Platte, Nebraska	1155	1051	1173	2406	2354	2486	6366
Oakland, California	446	455	496	1029	989	1099	3143**
Oklahoma City, Oklahoma	851	873	815	1340	1460	1379	3613
Omaha, Nebraska	1289	1150	1175	2347	2516	2284	6131
Oswego, New York	1218	1232	1138	2558	2723	2494	7088
Parkersburg, West Virginia	1091	1014	921	2099	2130	1830	4775
Peoria, Illinois	1328	1204	1150	2396	2569	2323	6109
Philadelphia, Pennsylvania	973	925	905	1788	1827	1735	4855
Phoenix, Arizona	340	351	425	574	485	581	1405
Pittsburgh, Pennsylvania	1092	1021	967	2079	2224	1949	5235
Pocatello, Idaho	1284	1125	1181	2860	2487	2649	6655
Portland, Maine	1277	1366	1159	2817	2926	2605	7218
Portland, Oregon	760	712	729	1578	1514	1724	4469
Providence, Rhode Island	1048	1073	1026	2083	2173	2130	6015
Pueblo, Colorado	1024	1087	1029	2183	2370	2164	5514
Raleigh, North Carolina	834	723	694	1483	1405	1253	3234
Rapid City, South Dakota	1220	1096	1172	2714	2555	2701	7118
Reading, Pennsylvania	1049	992	1001	2028	2080	2014	5389
Red Bluff, California	503	—	—	955	—	—	—
Reno, Nevada	978	1087	973	2310	2341	2284	5892
Richmond, Virginia	865	797	763	1577	1565	1380	3695
Rochester, New York	1294	1232	1125	2645	2767	2414	6732
Roseburg, Oregon	727	769	719	1579	1575	1741	4428
Roswell, New Mexico	825	859	808	1467	1576	1510	3484
Sacramento, California	532	524	574	969	933	996	2653
St. Joseph, Missouri	1194	1114	1079	2016	2247	1960	5161
St. Louis, Missouri	1106	1006	936	1848	1918	1738	4585
Salt Lake City, Utah	994	1045	1020	2032	2154	2149	5555
San Antonio, Texas	499	453	347	735	760	473	1202
San Diego, California	208	217	288	396	360	487	1645
Sandusky, Ohio	1208	1123	1063	2265	2373	2142	6208
San Francisco, California	337	356	428	886	760	949	3264**
Sault Ste. Marie, Michigan	1420	1435	1370	3272	3443	3247	9285**
Savannah, Georgia	494	403	397	743	686	598	1490
Scranton, Pennsylvania	1172	1167	1085	2465	2555	2274	6129
Seattle, Washington	714	681	719	1553	1589	1869	4934**
Sheridan, Wyoming	1279	1073	1320	2763	2633	3198	8008
Shreveport, Louisiana	630	561	499	950	1019	769	1938
Sioux City, Iowa	1342	1210	1265	2644	2761	2583	6898
Spokane, Washington	1132	1107	1057	2461	2493	2583	6355
Springfield, Illinois	1225	1129	1039	2502	2224	2002	5373
Springfield, Missouri	1088	1010	893	1868	2032	1674	4428
Syracuse, New York	1279	1248	1172	2632	2794	2491	6893
Tacoma, Washington	790	758	756	1771	1801	1951	5181**
Terre Haute, Indiana	1185	1066	992	2087	2170	1840	4872
Toledo, Ohio	1315	1206	1079	2557	2655	2189	6077
Topeka, Kansas	1118	1066	1008	1860	2085	1883	4969
Trenton, New Jersey	1028	1002	930	1997	2073	1760	4933
Utica, New York	1358	1354	1144	2886	2986	2537	6796
Valentine, Nebraska	1304	1142	1245	2813	2641	2725	7039
Walla Walla, Washington	981	989	896	1960	2077	1909	4808
Washington, D. C.	947	885	896	1777	1778	1741	4626
Wichita, Kansas	1037	1029	955	1735	1911	1783	4673
Williston, North Dakota	1475	1297	1591	3338	3040	3658	9323
Winnemucca, Nevada	1087	1042	1080	2519	2262	2589	6427**
Yakima, Washington	1090	1004	1091	2162	2194	2428	5599

†Nome data are for November
(a) Data not available.

*Includes August.
**Includes July and August.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

NEWS OF THE MONTH

Cheese Aged by Ultra-Violet

BOSTON—In an address before Boston Section, American Society of Refrigerating Engineers, recently, Dr. A. W. Ewell, consultant and refrigeration research specialist of Westinghouse, spoke in part on the aging of cheese protected by ultra-violet ray lamps. To reduce dehydration in the aging process, a relative humidity of 80% is desirable, he said. To speed the ripening, the temperature is raised to an average of 45-50F, about 15F higher than in aging rooms unprotected by the ultra-violet lamps. Thus the lamps permit acceleration of the cheese ripening process to a fraction of the time previously required but also reduce shrinkage by dehydration (this indirectly due to the higher humidity and temperature).

In addition to the bactericidal rays, Dr. Ewell explained that the lamps produce in the air a small amount of ozone, a colorless, gaseous form of oxygen used commercially for the purification of water and foods, particularly in egg and apple storage rooms. There are hard to reach surfaces in food storage and food processing which elude the ultra-violet. So the ozone, which in effect scatters rapidly from the lamp and is circulated throughout the storage space, steps in as an additional weapon to halt mold growth. At the same time the ozone concentration in food storage and processing rooms properly equipped with the bactericidal lamps never exceeds a few tenths of one part per million of air, which is too low to injure even sensitive foods.

In some unprotected storage spaces it is often impossible to obtain both the benefits of high humidity and freedom from bacterial contamination, said Dr. Ewell. The common practice has been to drop the temperature in storage spaces to a point where bacterial growth is drastically reduced. This point varies with the site of the storage compartment and the temperature cannot be reduced too far without affecting the humidity. A high humidity, for example, becomes impractical in domestic refrigerators as temperatures approach the freezing point.

Under low humidity, Dr. Ewell said, foods suffer surface "parching," lose moisture, weight and vitamin content and have their flavor, texture and color impaired. The great majority of foods are carried best at high humidities, ranging from 80 to 90%.

Oil Heat Group Elects Heaney

BOSTON—At the annual meeting of the Massachusetts Oil Heating Association Jan. 16, the following officers were elected for 1945: president, Fred W. Heaney; vice-president, Earle R. Gabeler; secretary-treasurer, Fred N. Beckwith; directors, John Ivester, A. J. Hally, Max Seltzer, N. A. Burkhardt, T. G. Colter, H. S. Carragher and J. L. Gamble.

Inside Temperature Reduction Urged

WASHINGTON—A widespread blackout of ornamental and outdoor advertising lighting was ordered January 10 by James F. Byrnes, war mobilization director, who also called for a 68F maximum temperature in all homes and public buildings.

"A 10% reduction in space heating is estimated to represent a saving of approximately 14,000,000 tons of coal annually," Mr. Byrnes' office said. "Therefore, the managements of all office buildings, hotels, apartments, stores and other establishments are urged to take immediate measures to maintain a maximum temperature of 68F in their buildings. In addition all residents of homes are ordered to take similar action."

Compliance with the 68F heating maximum was left on a voluntary basis, but Mr. Byrnes urged the public to cooperate "in the hope that coal rationing can be avoided."

Although the main emphasis was put on the bituminous coal-supply situation, officials said that the economy measures would apply to consumers of anthracite because of a "tight" situation in the supply of that type of fuel.

No figures on anthracite supplies were reported, but officials said that this year's estimated consumption of bituminous coal threatened to exceed production by 40,000,000 tons.

"The Secretary of the Interior, who is also Solid Fuels Administrator, estimates that it will be necessary to reduce the over-all consumption of bituminous coal by 25,000,000 tons during 1945," Mr. Byrnes said. "This is based on the assumption there is no stoppage of work during the year."

Secretary Ickes earlier January 10 had called on operators of large buildings in the easten part of the country to reduce heating temperatures to 70F or lower "at once" in order to conserve coal.

He also announced an order prohibiting retail deliveries of certain sizes of scarce Eastern-mined coals to large consumers already holding more than a fifteen days' supply.

The limitation applies to slack, nut-and-slack mixtures, mine run, pea, nut or stoker sizes of bituminous produced in Pennsylvania, northern and southern West Virginia, eastern Kentucky and part of Tennessee.

In explaining the necessity for conservation measures, Mr. Byrnes said that Mr. Ickes had reported that there had been a coal deficit the last two years and estimated that during 1945 bituminous coal requirements would be 620,000,000 tons, while only 580,000,000 tons would be produced.

The mine labor force has suffered severe reduction, Mr. Byrnes continued. In 1943 there were 435,000 men employed in the bituminous mines, while this year not more than 390,000 miners will be available.

The deficit in coal production in the last two years was made up by drawing on stock piles. Officials said, however, a stock pile of 77,000,000 tons on April 1, 1943, would be reduced to about 40,000,000 tons by next April 1.

$62 Million for Store A. C.

NEW YORK — America's merchants are planning to spend more than $62 million on air conditioning equipment after the war, according to a survey made by the National Retail Dry Goods Association of its member stores.

Conducted by the association's post-war planning committee, of which Saul Cohn, president of City Stores Co., is chairman, the survey covered about 10% of the group's membership.

The survey, as recently (Dec. 30) made public, showed that merchants are planning to spend more than a billion dollars for store modernization and improvements in the post-war period. Of the total, it was estimated, 6.2% will be for air conditioning.

Registration of California Engineers Discussed

LOS ANGELES—That heating and ventilating engineers be permitted to register as mechanical or electrical engineers, or both, only if they can qualify in those fields, was recommended by Paul E. Jeffers, Los Angeles industrial engineer, in an address at the November 8 meeting of the ASHVE.

Pointing out that a group known as the Industrial Engineer Society is attempting to obtain state legislation that would enable its members to engage in all branches of the engineering profession, Mr. Jeffers recommended that ASHVE chapters in California oppose such blanket registration.

He recommended that the Society support legislation for state registration of mechanical and electrical engineers and that heating and ventilating engineers be permitted to register as mechanical and electrical operators only upon proper qualification.

The Los Angeles ASHVE chapter voted to support Mr. Jeffers' recommendation. A committee was appointed by chapter president Leo Hungerford to cooperate with the state legislative group in efforts to obtain the proper type of legislation.

Arthur Theobald, chief engineer, Payne Furnace & Supply Co., Beverly Hills, Calif., discussed "Gas Heating Equipment and Its Installation."

Foundrymen Cancel 1945 Meeting

CHICAGO—Cancellation of the 1945 War Production Foundry Congress of the American Foundrymen's Association, scheduled to be held in Detroit, April 30-May 4, is announced.

Edison Electric Institute Cancels Conference

NEW YORK — The annual Commercial Conference of Edison Electric Institute, previously announced for March 26-29, at Edgewater Beach Hotel, Chicago, Ill., has been cancelled to meet the government's request that large conventions be discontinued. Although the annual meeting is cancelled, important committee meetings will be continued.

Urge U. S. Aid on Industrial Hygiene

WASHINGTON—The Federal Government was urged to provide more adequate facilities in its Department of Labor for consulting service to State labor departments in preparing health codes and similar work. This recommendation was made by the 11th National Conference on Labor Legislation, which met recently in Washington. The report of the Committee on Safety and Health and Workmen's Compensation recommended the following:

"The part of the Federal Government in contributing to a nation-wide control of industrial accidents should be directed principally in the following direction:

1. Providing more adequate facilities in the United States Department of Labor for direct advisory and consultative service to State labor departments, including technical assistance in the preparation of safety and health codes; assisting in the training of factory inspectors and in the dissemination of safety information and the stimulation of accident prevention programs among members of organized labor; promotion of labor participation in plant safety programs and in the distribution of safety educational material designed for both management and labor, together with the preparation of authoritative data on scientific engineering control methods and practices.
2. The Federal Government should make available to the several States, through their labor law administrative agencies, grants-in-aid in order to fortify the facilities and efforts of the States in combating accident and health hazards in all places of employment.

"Your committee again directs attention to the unrealistic, and largely nonproductive, allotment of Federal funds to the Public Health officers for the purpose of operating industrial hygiene units in States where the sole statutory authority and responsibility for industrial safety and health inspection and regulation is vested in the State labor departments. The use of funds for this purpose by State health departments has developed confusion, duplication of inspection, and increasing difficulty in enforcing the labor laws enacted for the protection of workers. The Public Health Service, having set up competing agencies without legal authority or responsibility, now openly opposes Federal grants to States for strengthening State labor departments, and has even claimed credit for blocking the passage of Congressional Bill—H. R. 2800—introduced at the request of labor for the purpose of building better State labor departments."

The committee was made up of representatives of labor and of various State labor departments, and included John W. Gibson, president, State Industrial Union Council of Michigan, who acted as chairman; Sidney R. Katz, secretary-treasurer, Maryland and District of Columbia Industrial Union Council; Arthur W. Ritzaur, commissioner, Industrial Commission, Florida; John G. Henneberger, president, Local 1008, United Steel Workers of America; Walter J. James, secretary-treasurer, United Mine Workers of America, Illinois; James T. Moriarty, commissioner, Massachusetts Department of Labor and Industries; George W. Dean, commissioner, Department of Labor and Industry, Michigan; George J. Paulson, field representative, Iowa-Nebraska State Industrial Union Council; Harry C. Harper, commissioner, New Jersey Department of Labor; Forrest H. Shuford, commissioner, North Carolina Department of Labor; W. A. P. Murphy, commissioner, Oklahoma Department of Labor; and Clarence L. Palmer, president, State Industrial Union Council of Utah.

Stoker Sales Show Increase

CHICAGO—Factory sales of mechanical coal stokers for the first 11 months of 1944 totaled 37,159 units of all sizes and types, compared with 30,861 units for the same period in 1943, according to a release issued by the U. S. Bureau of the Census based on reports furnished the Government by stoker manufacturing firms representing approximately 90 per cent of the total value of the industry output.

Class A sales—stokers having a capacity between 61 and 1200 lb of coal per hour—totaled 34,977 units for this time compared with 24,650 machines in the same period of 1943. Residential size stoker sales in 1944 were negligible because of WPB manufacturing restrictions in the fall of 1942. However, a limited production and sale of small stokers for home heating purposes has been permitted by the war agency and for the first time in two years, factory sales of these sizes took a noticeable jump as shown by the 555 units reported by 20 manufacturers in the month of November, 1944.

Nelson President of Fan Group

DETROIT—At the Twenty-Eighth Annual Meeting of the National Association of Fan Manufacturers held at Hot Springs, Virginia, on January 12, the following officers were elected for the ensuing year: R. H. Nelson, president; C. T. Morse, vice-president; and L. O. Monroe, secretary-treasurer. Mr. Nelson is president of The Herman Nelson Corp., Moline, Ill., and Mr. Morse is president of the American Blower Corp., Detroit, Mich.

To Study Bus A. C.

BUFFALO, N. Y.—The State Public Service Commission has ordered a study designed to effect improvements in bus construction after the war, including the use of air conditioning.

Gas Heat Group Discusses Performance

LOS ANGELES—An effort to extend the certified performance program on gas ranges to include gas heating met with opposition at a technical conference of the Gas Heating Council of the Pacific Coast Association here January 17 when the council went on record opposing extension of the CP program, as presently set up, to heating because it would not lend itself to heating unless more rigid machinery for inspecting the installations is also included in the plan. Represented at the conference were the seven major gas companies of Oregon, Washington and California, and 24 manufacturers of gas heating equipment.

The heating council indorsed the basic theme of the AGA plan—advancement of the quality of gas heating equipment and wider use of gas as heating fuel, but defined the CP heating plan, in its present form, as inadequate for meeting Southern California heating conditions.

Principal objection by representatives of both the utilities and manufacturers was voiced against the use of the term "certified performance." It was contended that performance of a gas heating system cannot be certified or guaranteed unless those making the guarantee have more effective supervision over those who install the heating equipment.

Five questions were submitted to vote, with each of the seven utilities and 24 manufacturers allowed one vote.

The council voted 20 to 0 in favor of some nationally operated program for improving the standards of gas heating equipment, provided due allowance is made for the fact that heating conditions are not identical throughout the country, and that effective machinery for inspecting installations is devised.

A unanimously negative vote was cast on the following question:

"How many favor the CP heating program as advanced in its present form by the AGA, providing for a definite assurance of certified performance and a national system of policing installations?"

The preponderantly opposing vote on the above question was influenced by the fact that a majority of utility and manufacturer representatives in attendance regarded the method of inspecting installations advocated in the AGA program as inadequate in that it does not definitely specify by whom the inspections are to be made—the gas company, equipment manufacturer, or some still unidentified agency.

Use of the term "certified performance" as applied to heating systems was opposed by a vote of 14 to 4. Various speakers pointed out that too many factors may contribute to the failure of a heating plant to make it plausible to issue a blanket indorsement in the form of certified performance, unless those making the indorsement have some control over installers.

New Courses in L. A.

LOS ANGELES—A course in water piping and piping for heating systems was inaugurated at the Frank Wiggins Trade School, Los Angeles, under the aegis of the Los Angeles Board of Education, on January 1, with Stephen I. Smoot of the Municipal Department of Building and Safety, as instructor.

Mr. Smoot has announced he plans to emphasize the need for uniformity in piping by using as the basis of his lectures interpretations of the requirements of the municipal codes of Los Angeles and adjacent communities.

Simultaneously, Southern California Gas Co. announced the opening of a series of weekly classes in thermostats and heat controls. The schedule calls for classes once a week, beginning January 17, at Burbank, Calif., with Michael Johnson of the gas company heating staff serving as instructor.

Howard M. Wylie

SOUTH NORWALK, CONN.—Howard McWilliam Wylie, 59, former vice-president in charge of sales of the Nash Engineering Company here, died Christmas Day, after a long illness.

Howard M. Wylie

Mr. Wylie, a graduate of New York University, was successively a design and erection engineer with the Westinghouse-Church-Kerr Company, an erection engineer with Bliss & Griffiths and the Wirebound Box Corporation, secretary of the Howard Automobile Company, design engineer for the Roland Gas and Electric Company and sales engineer for the Bishop-Babcock Company. In 1915 he joined the New York office of Nash, Pumping Equipment Manufacturers, as a sales engineer, and later became manager of the office.

In 1919 Mr. Wylie was made general sales manager. He was elected a director in 1921, assistant secretary in 1922, and vice-president in charge of sales the next year. He retired as vice-president and as director in 1942.

Mr. Wylie leaves a widow, a daughter, a sister, and two brothers.

John W. Pauling

CHICAGO—John W. Pauling, 55, of Minneapolis, vice-president of Minneapolis-Honeywell Regulator company, died suddenly January 17 while in Chicago on business. He suffered a heart attack and was pronounced dead at Wesley Memorial Hospital.

John W. Pauling

Mr. Pauling was born in Blackburn, Missouri, and came to Minneapolis-Honeywell as a salesman in 1923, after operating his own business in the heating field in St. Louis.

He is survived by his widow, Loretta Pauling, and two sons, Stanley and William, both in the Army.

Don R. Marsh

BUFFALO—Don R. Marsh, 63, factory manager of Buffalo Forge Company, died here December 21.

Don R. Marsh

Coming to Buffalo in February 1910, he went to work as a cost accountant for Buffalo Forge Company. Successively, he was head of the cost department, production manager and factory manager. He was elected a director of Buffalo Forge Company in 1930 and was also a director of Canadian Blower & Forge Company, Ltd.

Mr. Marsh is survived by his wife, a son, a daughter, and a brother.

O. K. Dyer

BUFFALO — Manager of the small-blowers department of Buffalo Forge Company, Orville Kirk Dyer, 65, died recently after a month's illness.

After graduation from college, Mr. Dyer came to Buffalo as a mechanical engineer and salesman for Buffalo Forge. Within a few years he became manager of the small-blowers department. He was a member of the committee for the standardization of mine ventilation appointed by the American Mining Congress.

Thomas B. Fordham

DAYTON, OHIO—Thomas B. Fordham, 54, president of the Leland Electric Company since 1937, died here December 16. Mr. Fordham attended Columbia University and New York Law School. He then engaged in industrial engineering with New York firms until the outbreak of World War I. After serving in the Ordnance Department throughout the war, Mr. Fordham became a partner in the firm of J. Lee Nicholsin and Company of Chicago, leaving the firm in 1920 to take the position of superintendent of Delco Light Company of Dayton. In 1921, he moved to Frigidaire Corporation of Dayton to accept the position of works manager.

He returned to private practice of industrial engineering in 1931, in which activity he continued until called to the presidency of Leland Electric in 1937.

Harold B. Lauer

LOS ANGELES—Harold B. Lauer, 51, vice-president of English & Lauer, Inc., air conditioning, heating and ventilating engineering firm, died January 3 as the result of an accident. He is survived by his widow, his mother, and a daughter.

Martin R. Carpenter

CLEVELAND—Martin R. Carpenter, consulting refrigeration engineer, died January 13. Mr. Carpenter was a specialist in ice rink construction and was the inventor of the Carpenter monolithic concrete floating floor, and the Carpenter system of connections for ice pools, rinks and ice cream machinery. He also invented a planer to smooth ice rinks and developed the shell and tube type brine cooler used in modern refrigeration. Mr. Carpenter was born in Janesville, Wisc. He began his career as a draftsman in 1889 in Chicago where he remained until 1893 when he went into the refrigeration field with the A. H. Barber Co. of Chicago. Later he became chief engineer for the Brunswick Ice Machine Co., New Brunswick, N. J., and subsequently worked for the Triumph Ice Machine Co. in Cincinnati where he began to specialize in ice rink engineering. He was a life member of the ASRE.

BOOK REVIEWS

Articles are abstracted for the convenience of the readers. Orders cannot be taken for the full length articles. Those desiring to obtain copies of the article referred to should write to the publishers of the respective articles.

PIPING HANDBOOK

In The Pipe Fitter's and Pipe Welder's Handbook of 152 3¾ x 5¼ in. pages is assembled basic information of value to the pipe fitter. The author, Thomas W. Frankland is instructor in steamfitting at the Washburne Trade School, Chicago. The material is assembled to show the practical man how to employ basic trade mathematics, and how to make the necessary calculations for pipe-fitting and pipe-welding layout work. Contained in the book are 42 reference pages. All data are of a practical nature and the explanations are easy to follow.

"The Pipe Fitter's and Pipe Welder's Handbook," Thomas W. Frankland, The Bruce Publishing Co., 540 N. Milwaukee St., Milwaukee 1, Wis. Price $1.25.

ARC WELDING

The second volume of "Practical Design for Arc Welding" and containing 100 new and different idea stimulators for use by designers, engineers and fabricators. Volume I appeared some months ago. The book is under the authorship of Robert E. Kinkead.

Cloth bound, 8¾ by 11½ in. Published by The Hobart Brothers Company, Hobart Square, Troy 1, Ohio. Price $3.50. Volume I was also priced at $3.50 and is obtainable from the same publisher.

BRIEF REVIEWS

FOREIGN WELDING TERMS—To supplement standard or engineering dictionaries, the American Welding Society has issued a Glossary of Foreign Welding Terms, 16 pages, price 50 cents. It is divided into four parts—German-English, French-English, Russian-English, and Spanish-English. American Welding Society, 33 West 39th St., New York 18, N. Y.

MINE VENTILATION—In coal mining small fans with or without tubing are frequently used to divert part of the air current passing a given point so as to attempt to ventilate some other portion of the mine. The Bureau of Mines, which has always opposed this practice, has published an information circular No. 7298 entitled, "Some of the Hazards of Auxiliary Fans in Coal Mines" and showing the dangers arising from the practice. 27 pages, multilithed, prepared by D. Harrington and R. G. Warncke. Available from the Bureau of Mines, Department of the Interior, Washington, D. C.

PSYCHROMETRIC CHARTS—Nomographs for psychrometric calculations on the basis of given dry and wet bulb temperatures at specified barometric pressures. In addition to dewpoint and relative humidity data, the heat content and mixing ratio can be obtained. Data are given in both English and metric units. Graphs were designed by E. Berl and G. A. Sterbutzel of Carnegie Institute of Technology. Monthly Weather Review, June, 1944, obtainable from the Superintendent of Documents, Washington, D. C. Price 20¢.

Rough turns slow the flow

CONSIDER how the wild mountain stream twists and turns, uses up energy cutting away at banks and boulders, fighting obstructions that impede its smooth flow. Smooth, efficient flow is assured in piping systems using Tube-Turn welding fittings. Every fitting is checked for inside smoothness.

Maximum efficiency of flow is important to industry. Other advantages of Tube-Turn welding fittings over other fitting types include: Greater strength, less weight, lower maintenance costs. Tube-Turn welding fittings permit greater flexibility of layout, are easier to insulate. Increased safety at points of highest pressure and longer life for the entire system are more reasons for specifying Tube-Turn welding fittings.

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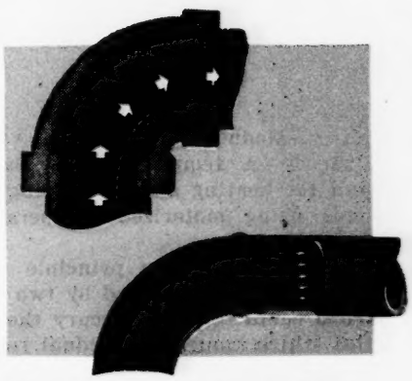


Compare for Smoothness

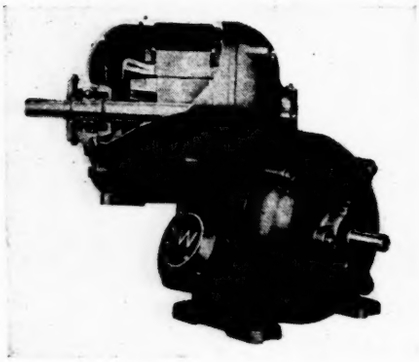
See how sharp corners and surface irregularities obstruct flow in cast iron threaded elbow. Compare for smoothness with unobstructed flow in smooth Tube-Turn elbow.

TUBE-TURN TRADE MARK *Welding Fittings and Flanges*

NEWS OF EQUIPMENT AND MATERIALS

Protected Type Motor

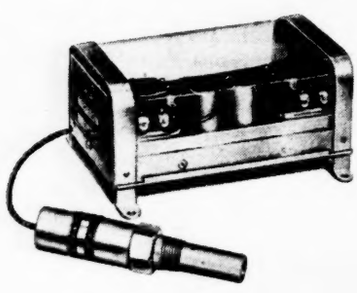
NAME—Protected type motor of the open type.
PURPOSE—A motor which combines the surplus capacity of the conventional open motor with protection against



dripping liquid and other foreign matter.
FEATURES—There are no openings in the frame or shields above the horizontal center line. Openings for ventilation have shielded construction. Centrifugal seals permit use of softer grease for longer bearing life. Motor has heavy cast frame construction, coils protected by vinyl acetal insulation, interchangeable front and rear shields, and guides for directing cooling air over all surfaces.
MADE BY—*Crocker Wheeler Division of Joshua Hendy Iron Works, Ampere, N. J.*

Modutemp

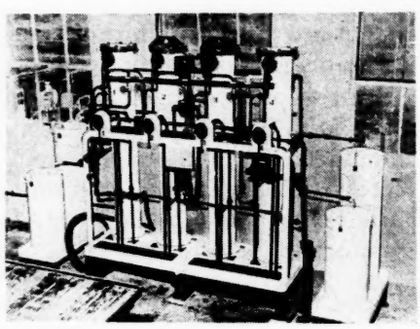
NAME—Modutemp.
PURPOSE—A temperature regulating unit for heating and ventilating systems using motorized dampers for control.
FEATURES — Employs principle of a temperature gap formed by two electrical contacts in a mercury thermostat which control individual relays. Contacts are set to meet temperature specifications and range of individual requirements. When mercury falls



below temperature gap, damper motor runs toward heat position and both relays apply electric heat to thermostat to assist mercury to rise again into gap. When mercury enters gap, motor operation stops and heat from No. 1 relay cuts off, slowing down rise of mercury. Damper holds this static position until mercury moves out of temperature gap between the two contacts. If mercury rises above gap, damper motor operates toward cool position and No. 2 relay cuts off remaining heat on thermostat tending to make mercury fall and reenter gap stopping damper movement. Device never hunts, is compact and light in weight. Aircraft type weighs 25 ounces. System may be specified to handle various sizes of motors. Where hydraulic or pneumatic power is used, Modutemp controls through operation of solenoid valves. Damper positions at any point necessary to satisfy thermostat and is *not* limited to steps or set number of degrees of movement.
MADE BY—*Vapor Car Heating Co., Inc., Railway Exchange, Chicago 4, Ill.*

Filt-R-Stil

NAME—Filt-R-Stil.
PURPOSE — A filtration device which transforms ordinary water into the chemical equivalent of distilled water by filtration. Especially intended for research laboratories, electronic

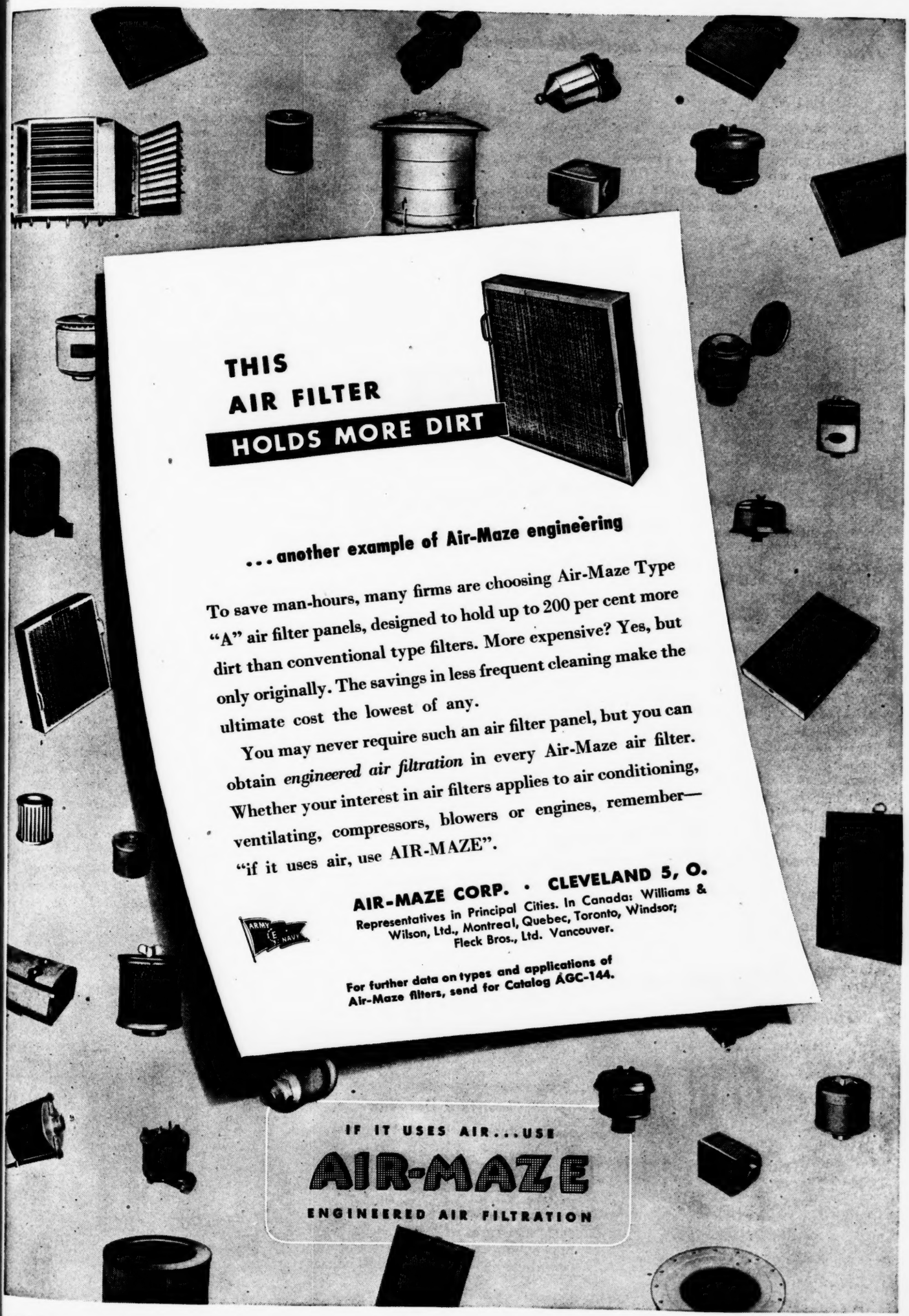


equipment fabrication plants, textile manufacturing, leather, paper, pharmaceuticals, food and other plants where mineral-free water is desired.
FEATURES—Water is filtered through melamine-derived and other resins. Water is passed through beds of these ion exchange resins which transform dissolved salts in water to corresponding acids and in turn absorb acids. Process may be visualized by picturing water as containing flowing metals which are attracted by a magnet except that magnet, in this case, is chemical rather than electrical. Unit illustrated is large portable type.
SIZES AND CAPACITIES—Portable unit in two forms, one for field and other for bench use, each with capacities of 8 to 10 gallons of de-mineralized water per hour. A laboratory unit has a capacity of approximately 30 gallons per hour. Also made in special sizes for large industrial users, such as boiler plants, textile mills and so forth.
MADE BY—*American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York 20, N. Y.*

Axial Flow Fans

NAME—Dynamic axial flow fans.
PURPOSE—For applications wherever axial flow fans are adaptable.

FEATURES—Built in both single stage and multi-stage type. Two-stage assemblies double the single stage pressure characteristics of any given unit. When multi-stage assemblies are built, guide vanes or contra vanes are employed to straighten air stream between stages.
SIZES AND CAPACITIES—Cover an extremely wide range from 2 in. to 60 in. fans; 2 in. unit powered by a two-thousandth hp motor, delivers 30 cfm at 0.30 in. of static pressure. This unit was originally designed for cooling of modulators in airborne electronic equipment. The 60 in. low pressure type is driven by a 10 hp motor, delivers 60,000 cfm free air and 5,000 cfm at ½ in. S.P.
MADE BY—*Dynamic Air Engineering, Inc., 1619 S. Alameda, Los Angeles 11, Calif.*


THIS
AIR FILTER
HOLDS MORE DIRT
... another example of Air-Maze engineering
To save man-hours, many firms are choosing Air-Maze Type "A" air filter panels, designed to hold up to 200 per cent more dirt than conventional type filters. More expensive? Yes, but only originally. The savings in less frequent cleaning make the ultimate cost the lowest of any.
You may never require such an air filter panel, but you can obtain engineered air filtration in every Air-Maze air filter. Whether your interest in air filters applies to air conditioning, ventilating, compressors, blowers or engines, remember— "if it uses air, use AIR-MAZE".
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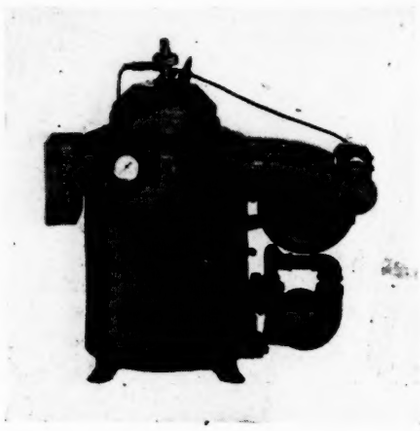
Representatives in Principal Cities. In Canada: Williams & Wilson, Ltd., Montreal, Quebec, Toronto, Windsor; Fleck Bros., Ltd. Vancouver.
For further data on types and applications of Air-Maze filters, send for Catalog AGC-144.
ARMY
NAVY
IF IT USES AIR...USE
AIR-MAZE
ENGINEERED AIR FILTRATION

Hot Water Heater

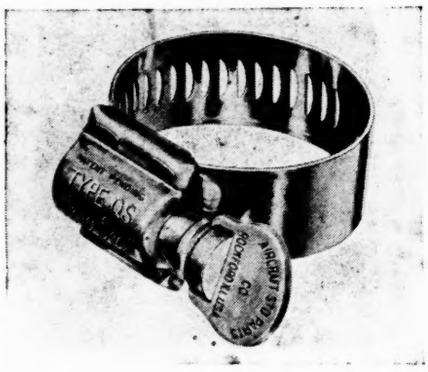
NAME—Model 4032 hot water heater.
PURPOSE—Recommended as source of hot water supply for heating systems in railroad cars or buildings. Particularly adaptable as a mobile unit for furnishing hot water or heat



through heat exchanger for heating lubricants or other solutions.
FEATURES—Unit operates on either diesel fuel or gasoline and can be supplied with AC or DC electric motor or single cylinder gasoline engine. Standard automatic control or vapor modulated control provided to specifications. Ignition is continuous with bypass control of fuel. Coil handles water or glycol solutions to meet Army and Navy specifications at temperatures up to 300F. Equipped for cold weather operating conditions.
SIZES AND CAPACITIES—Weighs less than 200 lb. Has output of 150,000 Btu per hr. Unit is 30⅞ in. high by 16 in. wide by 25 in. long.
MADE BY—*Vapor Car Heating Co., Inc., Railway Exchange, Chicago 4, Ill.*

Stainless Steel Hose Clamps

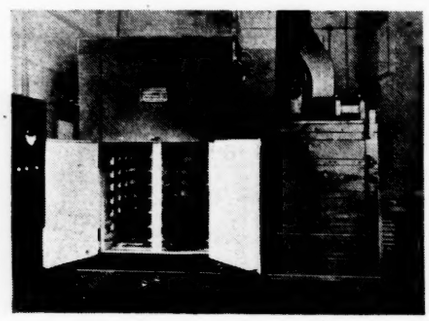
NAME—Aero-Seal hose clamps.
PURPOSE—For service where conditions require high corrosion resistance.
FEATURES—Made of stainless steel.



Although lighter and thinner, stainless steel bands are said to have greater strength and flexibility than carbon steel clamps, and have advantage of being made entirely of rust-resistant material. Mechanically interlocked saddle permits elimination of welds at that vital point.
SIZES AND CAPACITIES—At present in M12, M16 and M20 sizes, but eventually all sizes from ½ to 4¼ in.
MADE BY—*Aircraft Standard Parts Co., 1727 19th Ave., Rockford, Ill.*

Drying Oven

NAME—Box type oven.
PURPOSE—For evaporation and drying for highly volatile solvents and liquids.
FEATURES—Unit is self-contained, with heating equipment and ductwork built into oven shell, shipped either assembled or in pre-fabricated sections for assembly at point of operation. Ovens can be used for alcohol, acetone, naphthas, methyl-ethyl-ketone, and other high volatile



solvents; can also be converted for other types of drying, finishing, heat treating or heat processing where materials can be handled in trays, jigs or baskets.
SIZES AND CAPACITIES—Oven illustrated is standard size with a preheating zone added, latter heated by exhaust air from oven proper. Door sizes from 3 x 3 ft to 5 x 6 ft, and working depth from 3 to 6 ft. Temperature range from 150F to 900F.
MADE BY—*The Industrial Oven Engineering Co., 11621 Detroit Avenue, Cleveland, Ohio.*

Moisture Detector

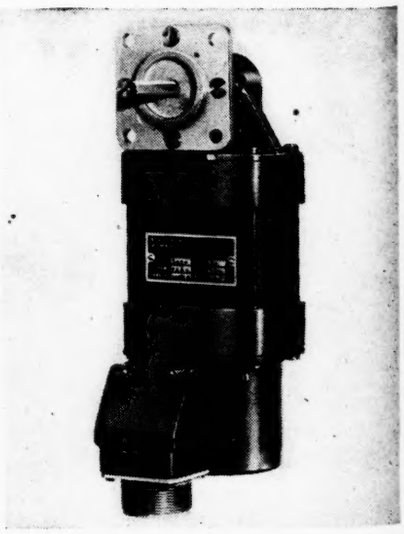
NAME—Model R Delmhorst moisture detector.
PURPOSE—For measuring moisture in wood, plastics, masonry, and other materials.
FEATURES—Covers a range of 7 to 25% moisture with an accuracy of plus or minus 1%. Complete and self-contained. Used by forcing electrode needles into material being tested, reading then taken by turning dial knob until a small light above dial flashes at correct moisture content.
MADE BY—*Colloid Equipment Co., Inc., 50 Church St., New York, N. Y.*

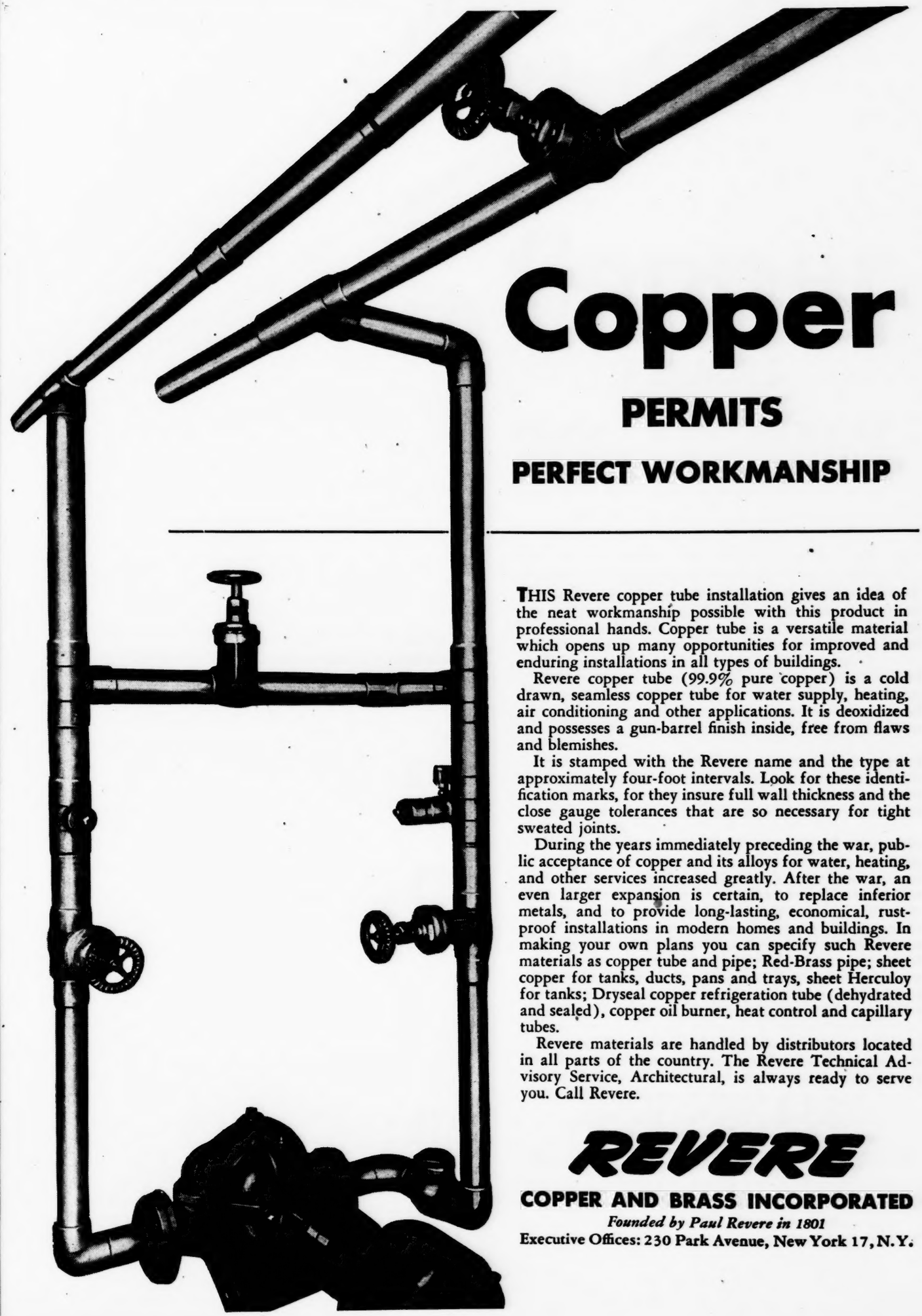
Synthetic Resin Cement

NAME—Duracite.
PURPOSE—To provide an alkali and acid resistant cement for bonding brick or tile.
FEATURES—Material comes in the form of a liquid and powder and can be stored indefinitely before mixing. Setting time can be controlled. Cement is inert to all alkalies, fats, oils and solvents and to all acids except high concentrations of highly oxidizing acids such as nitric and chromic. Substance is dense and the absorption is claimed to be less than 0.005%.
MADE BY—*U. S. Stoneware Co., 60 E. 42nd St., New York, N. Y.*

Angle Blower Drive Unit

NAME—Angle blower drive unit.
PURPOSE—Fractional horsepower electric motor drive unit designed for cabin-heater drive in the Army's Douglas A-26 bomber.
FEATURES—Light weight, continuous duty type, ½ hp, fan cooled, 7000 rpm motor equipped with right angle gear box and drive shaft. Gear ratio of 1 to 1. Overall efficiency said to be 70%. Motor frame number 6220. For use in a 28 volt system. Self-contained unit engineered to fit in restricted space within existing airframe structure.
LITERATURE AVAILABLE—Motor type catalog.
MADE BY—*Electrical Engineering and Mfg. Corp., 4606 West Jefferson Blvd., Los Angeles 16, Calif.*





Copper

PERMITS

PERFECT WORKMANSHIP

THIS Revere copper tube installation gives an idea of the neat workmanship possible with this product in professional hands. Copper tube is a versatile material which opens up many opportunities for improved and enduring installations in all types of buildings.

Revere copper tube (99.9% pure copper) is a cold drawn, seamless copper tube for water supply, heating, air conditioning and other applications. It is deoxidized and possesses a gun-barrel finish inside, free from flaws and blemishes.

It is stamped with the Revere name and the type at approximately four-foot intervals. Look for these identification marks, for they insure full wall thickness and the close gauge tolerances that are so necessary for tight sweated joints.

During the years immediately preceding the war, public acceptance of copper and its alloys for water, heating, and other services increased greatly. After the war, an even larger expansion is certain, to replace inferior metals, and to provide long-lasting, economical, rust-proof installations in modern homes and buildings. In making your own plans you can specify such Revere materials as copper tube and pipe; Red-Brass pipe; sheet copper for tanks, ducts, pans and trays, sheet Herculoy for tanks; Dryseal copper refrigeration tube (dehydrated and sealed), copper oil burner, heat control and capillary tubes.

Revere materials are handled by distributors located in all parts of the country. The Revere Technical Advisory Service, Architectural, is always ready to serve you. Call Revere.

REVERE

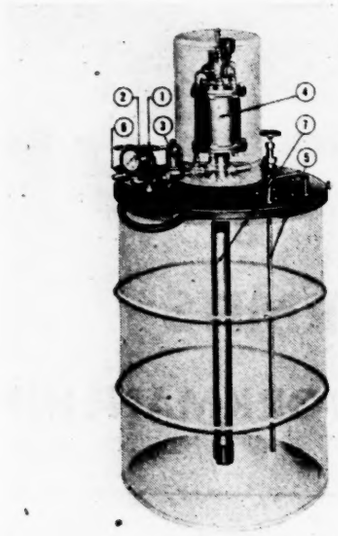
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue, New York 17, N.Y.

Versatal Pump

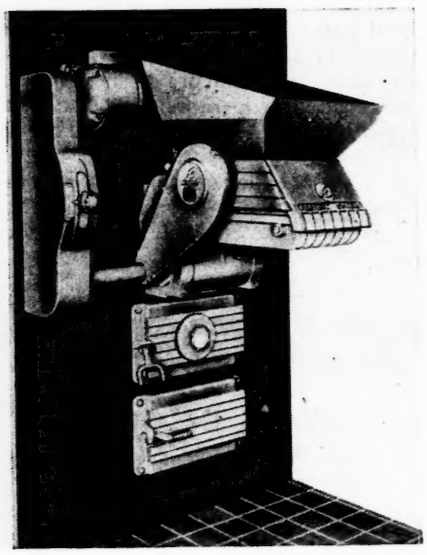
NAME—Alemite Versatal pump.
PURPOSE—For handling heavy or light consistency materials such as paints, compounds, varnishes, under extremes of heat or cold.



FEATURES — Operates on air power. Material delivered to pump at pressures from 4½ to 5½ times the air pressure introduced to pump.
SIZES AND CAPACITIES—Available in two sizes of stationary barrel pumps and in a portable model. Illustration shows phantom view of barrel-type pump.
MADE BY—*Alemite, Div. of Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago, Ill.*

AE Perfect Spread Stoker

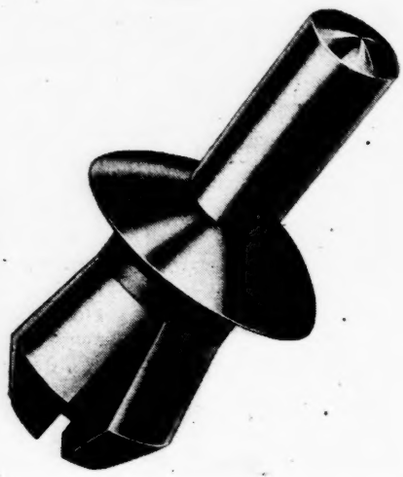
NAME—AE Perfect Spread stoker.
PURPOSE—For all grades of solid fuels.
FEATURES—Said to be extremely clean and quiet in operation; overthrow method of firing.



SIZES AND CAPACITIES—From 175 hp to 200,000 lb of steam per hr.
LITERATURE AVAILABLE — Bulletin "More Steam at Lower Cost."
MADE BY—*American Engineering Co., Philadelphia 25, Pa.*

Plastic Blind Rivet

NAME—Des-Rivet.
PURPOSE—A fastening for metal, wood and plastic components.
FEATURES—Rivet, which is moulded in one piece, is applied by pressing the tapered fingers into a drilled hole. Rivet and work are held together by the pressure of the depressed fingers. Impact from the rivet gun shears the plug and drives it into the plastic shank until the plug is flush with both ends of the rivet, maintaining the contour of the rivet head. Wedge action of the plug in the tapered shank expands the fingers against the walls of the drilled hole and upsets the shank end of the rivet.
LITERATURE AVAILABLE—Brochure giving possible uses of rivets.



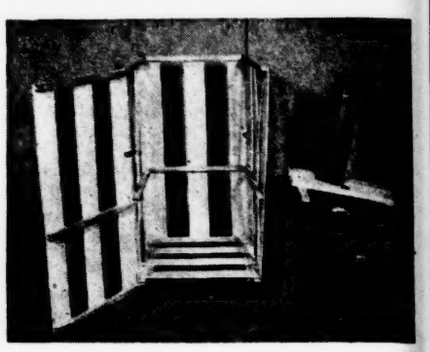
MADE BY—*Victory Manufacturing Co., 1105 Fair Oaks Ave., South Pasadena, Calif.*

Watersorber

NAME—Watersorber.
PURPOSE—For chemical dehumidification.
FEATURES — Consists of a receptacle arranged in three trays, one below the other. Air passes over the adsorbent and is dehumidified when it emerges from top of the receptacle.
SIZES AND CAPACITIES—Unit said to service from 800 to 1000 cubic feet. Cubes (adsorbent) available in 10 lb cans.
MADE BY — *General Air Conditioning Company of Oakley, Cincinnati, Ohio.*

Oil Burner Crates

NAME—Wirebound crates.
PURPOSE — To reduce damage caused to oil burners in shipment.
FEATURES—Wirebound crate redesigned to enclose product completely so



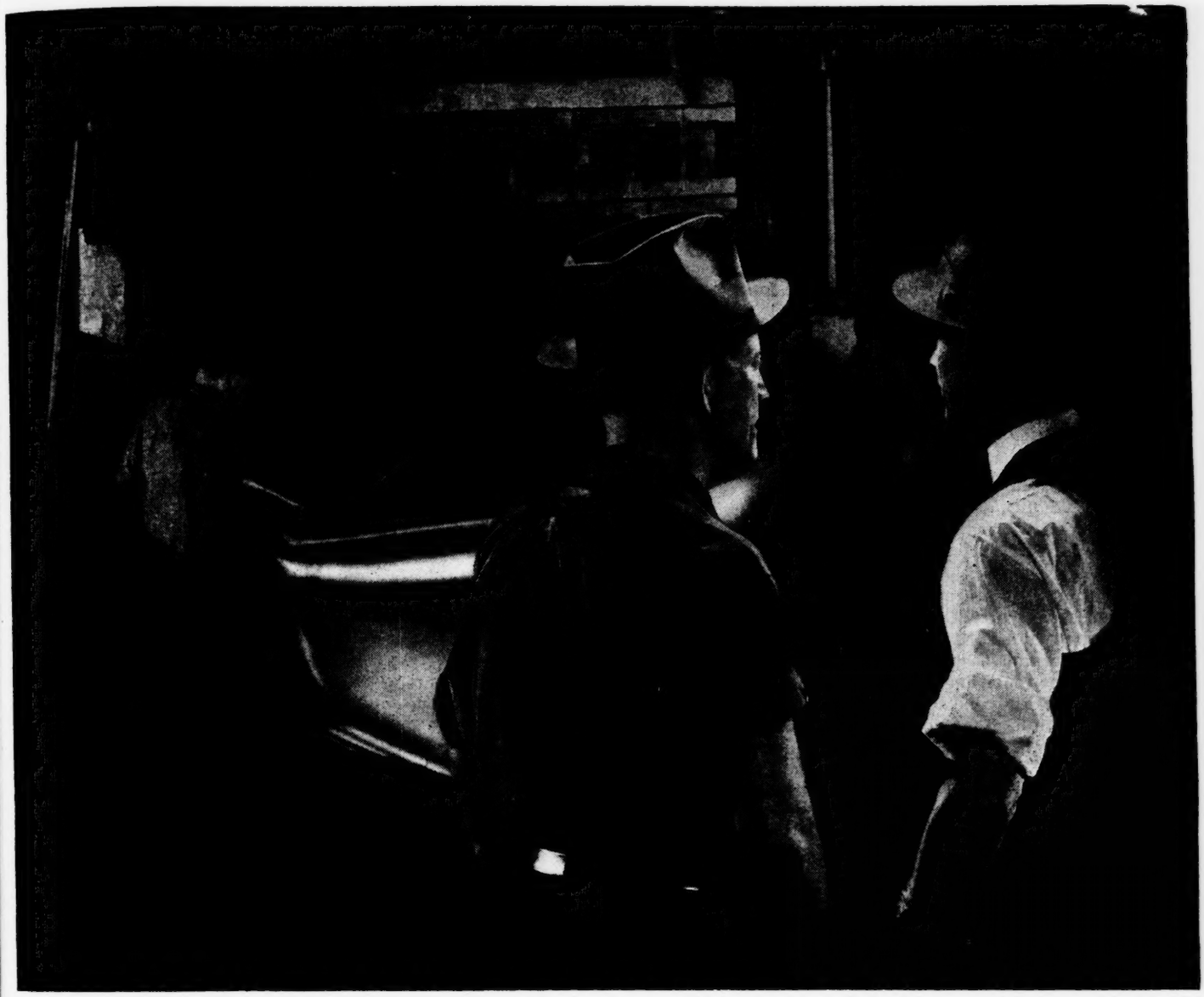
that full protection in transit is given projecting tube as well as oil burner motor. Burner is suspended inside crate; this is accomplished by wooden braces placed between draft tube and motor. Braces are supported by intermediate cleats inside the crate, and hence hold oil burner steady. Four nails are required in the assembly of the crate.
MADE BY—*General Box Co., Chicago, Ill.*

Welding Clamp

NAME—No. 622 steel clamp.
PURPOSE—For holding material when welding.
FEATURES—Frame, slide and screw are of steel. Slide is made of heat-treated steel. Simple in design, yet will not slip on pipe under pressure but is easily released when pressure is removed. Clamping surface is 1½ by 1½ in.
SIZES AND CAPACITIES—½ in. pipe (not furnished) is used to support the clamp. Clamp of any size opening up to length of pipe used can be made.
LITERATURE AVAILABLE—Bulletin 622.
MADE BY—*Cincinnati Tool Co., 4023 Montgomery Rd., Cincinnati 12, O.*

Indicating Light

NAME—Deluxe No. 659 D/E shallow-depth indicating light.
PURPOSE — For use in instrument panels and similar applications where unusually shallow depth is required.
SIZES AND CAPACITIES—Overall depth behind front of panel to extreme end of installation barrier is 1 in. It is for single-hole mounting in a 1⅜ in. hole in panels up to ¼ in. thickness. 120 volts.
MADE BY—*H. R. Kirkland Company, Morristown, N. J.*



THEY'RE *counting on* BETHLEHEM SHEETS

Men who know their steel sheets—men who work at forming and drawing operations day after day—know that Bethlehem Cold-Rolled Sheets do a consistently good job because they're uniform, ductile and easy on dies.

Under pressure of wartime needs, Bethlehem Sheets have come through—and brilliantly—drawing operations more drastic than were dreamed of a few years ago. When the fighting is finished, users of Bethlehem Sheets will be putting this wartime experience to good account.

Makers of refrigerators, automobiles, metal furniture, gasoline pumps, heating and ventilating apparatus, and other equipment in vast variety, together with sheet-metal contractors—they're counting on Bethlehem Sheets to do a postwar job for them.

They know their finished product will not only have high performance-appeal, but will also show real eye-appeal, thanks to the fine surface finish and all-around high quality of Bethlehem Sheets.

★ BETHLEHEM STEEL ★

What Our Readers Say

Window-Sill Distribution

EDITOR, HEATING AND VENTILATING:

T. W. Reynolds' interesting discussion in the November issue of an overloaded air conditioning job makes some mention of window-sill grilles used for air delivery in an induction system, from which installation he draws the "Moral: Never install horizontal window grilles."

From his description of the job conditions, I am led to wonder whether his adverse criticism of this type air distribution is perhaps drawn only from observations of either a poorly designed and applied system or else a good installation stepped up to operate at considerably above its design capacity in an attempt to cope with the overload conditions he describes. From the plan Mr. Reynolds shows, it looks as though the trouble could possibly be a combination of both causes.

A properly *applied, designed, and operated* window-sill distribution system generally gives better results both summer and winter than any other method using air distribution alone. Going a step farther, radiators or convectors would be required under the windows if the return or recirculation grille were not used. Either way a heating or air conditioning job would be the butt of loud complaints if a worker has to camp too near a grille, radiator, convector, or large window unprotected by one of the three.

Mr. Reynolds ought to refer to some modern induction systems; i.e., Carrier's "Weathermaster" installations before he does such broad moralizing.

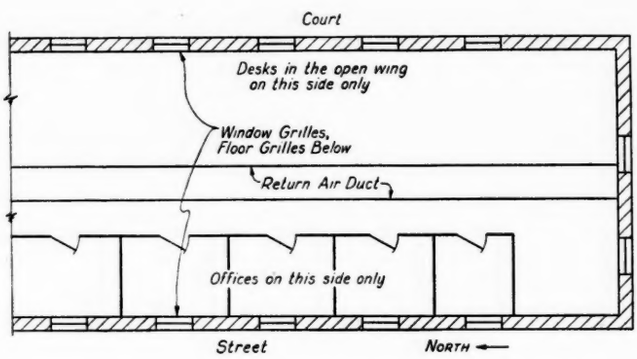
Seattle, Wash. *Richard M. Stern*

Mr. Reynolds Replies

EDITOR, HEATING AND VENTILATING:

The broad moralization referred to was in reference to the liability of interference with circulation of air from any outlet in a horizontal position. Such interference comes about by occupants of the space covering the outlets, either as done to suit their individual and perhaps peculiar requirements or ideas, or as thoughtlessly done in providing a convenient reference or storage point for books, papers and other objects. The writer objects to any system with this inherency and especially so where authority is lacking in enforcing the rule to keep window-sills free from all objects.

One can cite many reasons why the rule is seldom enforced. Years ago in banks and other buildings it was found that heating systems dependent on window-sill air delivery could be made foolproof only by sloping the sill. Even in systems where grilles are installed close to the ceiling it has been learned that occupants of multi-room buildings will interfere with the discharge from outlets.



Mr. Stern brings into the picture a second question, one as to the suitability of this type of system. The writer did not. The writer's experiences in this connection are limited to four installations of such systems, unfortunately all of which were troublesome. In other words, the writer has yet to encounter one which works, which may prove something or nothing.

First, there was the system under discussion, in which conclusions were not formed by mere observation, as implied, but by a personal occupancy of over a year plus a study and report as requested by management occupying the space. The management operating the space seems to be intelligent, but has not been able to satisfy either former or subsequent occupants. Toward the end of his sojourn in this building the writer moved his desk for administration reasons to two other locations on upper floors and found conditions even worse. Management, in defense, suggested lack of trained service men to adjust and maintain thermostats. The system could not seem to ride along by itself.

One of the second floor spaces is shown in the accompanying drawing. Offices installed along one side of the wing caused some of the troubles and to a degree dependent upon whether or not the office doors were closed. The entire system just seems to be one that has to be handled with kid gloves and is not very flexible as to changes.

Across the street from this building is another building with a similar system and similar troubles; furthermore, eventually the writer spent several months in a third building in the same city and again encountered one of the same troubles. In this last named location, the draft under the writer's desk to the return grille eventually gave him rheumatic legs. Though now back in New York City for some months the writer still has this trouble to a certain extent. A radiator or convector would not have provided so much draft nor been as objectionable. Why is either needed if there is no return grille? Case 4, for example, as follows, was all warm air with no return grille. In this last named installation (Case 4), the writer spent some time at the start of the war in solving difficulties with horizontal window-sill deliveries. This was in the offices of a war plant in New Jersey. Incidentally, all installations as cited were designed and installed by capable talent and not so many years back. Will more modern induction systems be as soon referred to as *passé?*

In general, it has always been known that one should not sit too close to either a return air inlet or exhaust outlet. The writer's desk in the crowded installation under question was for some time next to one of the return outlets. The writer finally moved, others tried it out, but in time the space, even though shielded, had to be abandoned to storage.

Whether the trouble in the first installation was due to design, application, or overload is determinable from the data previously published and as supplemented by the following data. Lighting 113,000 watts; floor 26,200 sq ft; skylight 2,200 sq ft; window glass 570 sq ft; 30 in. concrete wall, 2,100 sq ft; ceiling 11 ft 6 in; 33,000 c.f.m. of air circulated.

New York *T. W. Reynolds*

(Concluded on page 112)

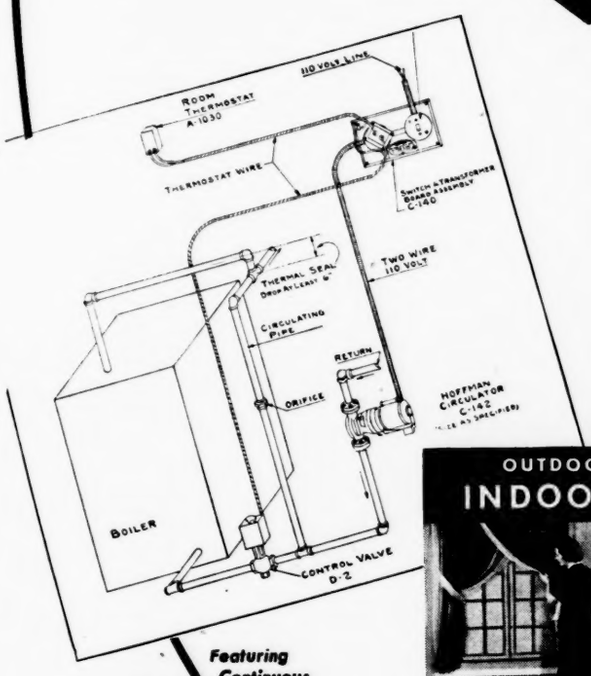
A NEW HOFFMAN HOT WATER *Comfort Package*

A popular-priced Continuous Circulation system . . . *thermostatically controlled*

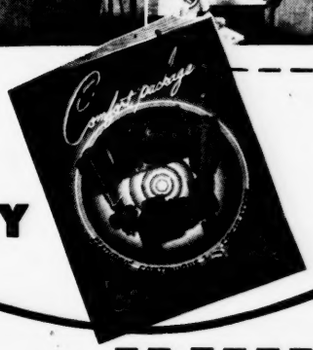
All the advantages of a continuously circulated forced hot water heating system can now be obtained with simplified and inexpensive equipment. The new Hoffman Comfort Package combines a Circulating Pump, Control Panel, Control Valve and Thermostat—adaptable to any hot water heating system.

In operation, the Comfort Package effects a constant balance between heat loss and heat supply, so that home temperature is held uniform, regardless of weather variations. Note in the diagram that the boiler is by-passed from the rest of the circulating system. Hot water from the boiler is admitted *only* when the temperature of the circulating water drops below the temperature required by weather conditions. Hence the system keeps pace with the actual need for heat and never delivers a fuel-wasting excess.

The Hoffman Comfort Package offers heating at its best, yet the cost is within the budget of even modest homes. Send the coupon for booklet.



Featuring Continuous Circulation



HOFFMAN SPECIALTY COMPANY

1001 York St., Indianapolis 7, Indiana

Makers of Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems . . . sold everywhere by wholesalers of Heating and Plumbing Equipment.

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1001 York St., Dept. HV-2, Indianapolis 7, Ind.
Send at once your booklet on the new Hoffman Comfort Package.

Name..... *Title*.....

Firm Name.....

Address.....

City.....*State*.....

WHAT OUR READERS SAY

(Concluded from page 110)

Radiant Heating

EDITOR, HEATING AND VENTILATING:

I have read with interest your article "Answers to Radiant Heating Questions" in the January, 1945, issue of HEATING AND VENTILATING. Having built such systems in Europe and having carried on extensive research work for the Chase Brass & Copper Company, I would like to offer some comments.

To Question 3: We have carefully computed the radiant and convective output of ceiling, wall and floor panels—the computations were based on practical test readings—and found that for an "average" room, the radiation output is 68%, 52%, and 47% for ceiling, wall, and floor, respectively. These values not only change with changing panel size and temperature and varying room temperature but also with the geometrical relation of heated and unheated area; however, it seems quite unlikely that a radiation ratio as high as 92% can be received unless temperatures are used that exceed extremely the presently considered "maximum" panel temperatures.

To Question 6: In all floor heated systems the floor surface temperature restricts the design of the entire panel. In cases where floors of high conductivity are used the water temperature must be relatively low or otherwise the floor surface would exceed 85F. If we apply a "further layer" to the old floor surface, we decrease the floor conductance but, naturally, may readily compensate this by increasing the water temperature to such a degree that the desired panel temperature (85F) is received again. For this reason it is not surprising that the described hangar functioned as desired—with or without wooden panel cover. However, if one has to deal with systems where several rooms are heated by water on one temperature and one of the rooms is heavily carpeted, it will be found that this room is underheated. If one tries to compensate by increasing the water temperature the carpet covered room will readily heat up to the desired C.T., but will overheat all other rooms.

To Question 7: If radiant systems are usually operated at a much lower water temperature, the reason for this phenomenon is the fact that so far no computation method was known that could give the Btu output of 1 sq ft of panel for any given panel structure, tube spacing, and water temperature. Since no analytical method was available we had to base our design on relatively scarce statistical data, and for this reason had to "overdimension" our systems to guarantee for the required heating effect.

To Question 8: I agree with the article that fuel savings must be smaller than 50%. In fact, I cannot see, that for an average building, such savings exceed 20% at the most. Here again the saving is dependent upon the relative location of panel and outside wall. Optimum fuel consumption is achieved if the panel does not cover the entire ceiling and its location relative to the outside wall is selected according to certain considerations (form factors, heat loss through conduction).

To Question 10: In general, the statement that, by increasing the water temperature from 110 to 140F, the panel output may be increased for 100% is true. However, this statement is again restricted by the panel surface temperature in the case of a floor heating system. If this system was designed for an 85F floor temperature an increase of the output by increasing the water temperature—or by any other means—is impossible.

Chase Brass & Copper Co., Waterbury, Conn. — *R. G. Vanderweil, Project Engineer.*

Getting Personal

Arthur N. Kugler

A background of 16 years of welding experience was drawn upon by **Arthur N. Kugler** in the preparation of his new series of articles on The Welding of Process Piping which starts in this issue on page 57.

Born and educated in New York City, he received his ME degree from Stevens Institute of Technology, Hoboken, N. J., in 1925.

For the next three years he was associated with Barker & Sheeler, consulting engineers on survey, design and the construction of hydro- and steam-electric power plants. From 1928 to 1929 he was installation and service engineer on talking motion pictures for RCA Photophone, Inc.

From 1929 to date he has been with Air Reduction Sales Co., in the applied engineering department, specializing in the application of welding to various industries. He has done extensive work in welding piping for oil, gas, steam and water service, and he has prepared a number of welded machinery designs.

Mr. Kugler is on many technical committees of the American Welding Society, consultant to the Chemical Warfare Service, U. S. Army, on the editorial committee in the preparation of a pipe welding manual for the Heating, Piping & Air Conditioning Contractors National Association, and on technical committees of the American Standards Association, and the International Acetylene Association.

Both he and members of his family are keen about figure skating. While the country is dubious about its coal pile reserve, he worries and speculates about how good the ice will be around Ridgewood, N. J., for his favorite sport.

Capt. Benjamin S. Malin (Industrial Exhaust Systems, page 75), formerly with the Industrial Division, Ordnance Department, has been transferred to the Corps of Engineers, U. S. Army, for foreign service. His biography appears on page 110, June, 1944 issue, in connection with his article, Dust Collecting System in Gunstock Plant.

. . . Since the Last Issue

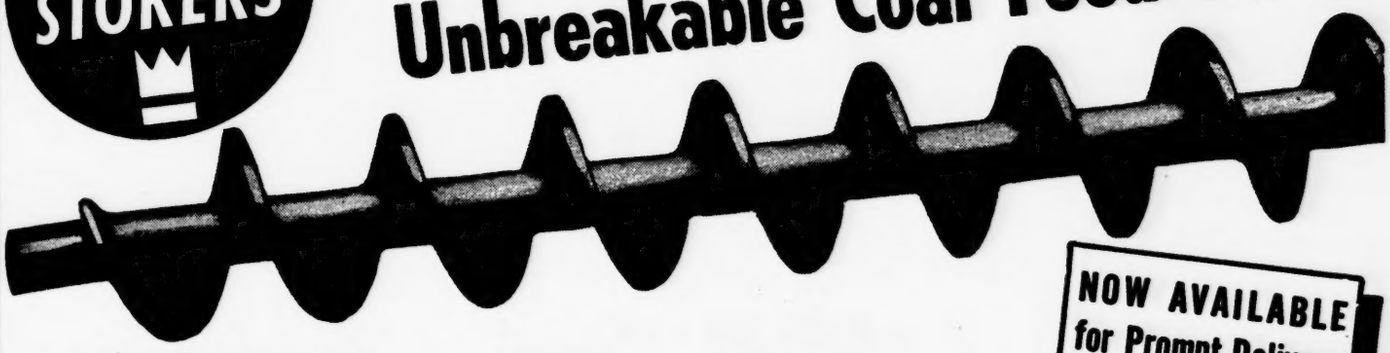
Roland A. Wank, internationally known in architectural circles, has resigned as head architect of the Tennessee Valley Authority to join the designing staff of **Albert Kahn Associated Architects & Engineers, Inc.** Previously he was in active charge of the TVA assignment, a position he has held since 1933. Mr. Wank is also listed in "Who's Who" as chief consulting architect of the Rural Electrification Administration.

Horace A. Green has been appointed to represent **Modine Manufacturing Company,** Racine, Wis., in Montana, Idaho and Wyoming. Mr. Green operates out of Missoula, Mont.

(Continued on page 114)

For STOKERS

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★For replacement or production needs, Crown is now able to offer for prompt delivery its all-steel Coal Feed Screw. Available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. For both domestic and industrial stokers, the Crown Coal Feed Screw insures longer and continuous operation because it is all-steel and because it is machined so smoothly that wear is reduced to a minimum. This smooth surface is your assurance, too, that coal will flow freely and easily through the flights. Prompt delivery is possible because production requires less time on Crown's automatic machines and because the steel used in Crown's Coal Feed Screw while critical, is more easily procured.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY

1229 Tyler St., N. E. *Since 1878* Minneapolis, Minn.

An AIRTHERM Direct Fired Unit Heater Will Reduce Your Heating Costs . . .

Airtherm Direct Fired Unit Heaters are designed for *efficient, controlled* heat which reflects a saving in your fuel costs. They can be installed in just a few hours without costly duct work, radiators, or pipes. They can be operated only when heat is needed without danger of freezing pipes, thus eliminating costly stand-by operation.

Airtherm Direct Fired Unit Heaters are built in standard sizes, with capacities from 300,000 to 1,500,000 BTU's.

Let us show you how we can reduce your heating costs. Send us your specifications or write for complete bulletin today.

AIRTHERM
MANUFACTURING COMPANY

722 South Spring Avenue • St. Louis 10, Missouri

(Continued from page 112)

General Controls Co., Glendale, Calif., has appointed **James King** as field sales engineer in its New York factory branch, 101 Park Avenue. Mr. King will serve users of automatic controls, particularly in industrial fields, throughout Metropolitan New York. His background includes sales and service experience with Jenkins valves in New York, New Jersey, and Texas. More recently he handled industrial oil sales for Pure Oil Company in New York.

James King

Arthur N. Goff, Fond du Lac, Wis., 68, dean of **Modine** representatives, died in Fond du Lac December 24. Mr. Goff pioneered the sale of the light-weight, suspended-type unit heaters developed by Arthur B. Modine in the early twenties and was the oldest Modine representative in years of service.

W. F. Lisman, former vice-president and general manager of **Leland Electric Co.**, Dayton, O., has been elected president of the company to succeed the late Thomas B. Fordham. Mr. Lisman, a graduate of Rose Polytechnic Institute, joined Leland in 1933 as a salesman, and two years later was made manager of the Chicago office. In 1937 he was moved to Dayton as general sales manager, became a vice-president in 1938, and general manager in 1943. George R. Gaskell, secretary-treasurer, was made vice-president and a member of the board of directors. Mr. Gaskell, who will retain his position as secretary-treasurer, was formerly senior vice-president of the Winters National Bank and Trust Co. of Dayton. Leland's vice-president in charge of engineering, Earl B. George, was also added to the board of directors.

Young Radiator Co., Racine, Wis., has re-equipped its engineering department with an Ozalid type B white print machine, a new dark room with a photocopy machine with a continuous rotor drum drier and acid resistant washing tanks, twenty new Hamilton Auto-Shift drafting tables, fluorescent lights, and a Vari-Typer machine for typewriting on drawings.

Badger Corporation, Milwaukee, Wisc., has announced a change in its sales policy. Ed Berge, president, states that sectional sales agents are now being appointed to represent the Company's complete line of air filters. There are a few territories still open for which agents will be appointed.

Clinton C. Fuller, assistant treasurer and assistant secretary of **American Blower Corporation**, has been elected to membership in the Controllers Institute of America.

Buffalo Forge Company has appointed **N. R. Johnson** factory manager. Mr. Johnson has been connected with the company for 28 years and for a number of years has been general purchasing agent. His outside contacts, as well as a thorough knowledge of the company's products and manufacturing problems fit him particularly well for the new post.

N. R. Johnson

H. D. Hebard has been appointed director of purchases. Mr. Hebard has been with the company for 24 years, most of this time in sales work. For the past three years he has been assistant to Mr. Johnson in the purchasing department.

Prof. J. Mack Tucker, associate professor of mechanical engineering at the University of Tennessee, has been appointed editor of *Refrigeration Abstracts*, a new publication of the **American Society of Refrigerating Engineers** to appear next fall. Prof. Tucker will retain his connection with the University and have editorial offices there. The new publication, according to advanced reports, will be useful both to research men in many branches of refrigeration and allied sciences as well as those engaged in other branches of refrigeration. Coverage of both English and foreign publications is contemplated in two issues a year.

The Foxboro Co., Foxboro, Mass., has appointed **Wendell A. Melton** as district manager in charge of the Tulsa territory, with offices in the McBirney Bldg., Tulsa 3, Okla.

The board of directors of **Worthington Pump and Machinery Corporation** has elected **Clarence E. Searle** president of the Corporation to succeed **Harry C. Beaver**, who was elected vice-chairman of the board of directors,

Hobart C. Ramsey

Clarence E. Searle

and chairman of the management committee. Mr. Beaver has been president of the Corporation since 1931, and Mr. Searle has been vice-president in charge of sales since joining the Worthington organization in 1932, following a long period of service in various executive capacities with Allis-Chalmers. **Hobart C. Ramsey**, vice-president in charge of operations, was elected executive vice-president. **Edwin J. Schwanhausser**, vice-president in charge of manufacturing and sales operations in Buffalo, was elected vice-president in charge of sales. **Leslie C. Ricketts**, manager of the Harrison Works, was elected a vice-president.

In accordance with the request of Director of War Mobilization Byrnes to save non-essential travel and hotel accommodations, the executive board of the **American Gas Association** has cancelled the A.G.A. War Conference on Industrial and Commercial Gas scheduled for Toledo, March 29-30.

The Permutit Company, New York, manufacturers of water conditioning equipment, has elected **W. Spencer Robertson** as chairman of its board of directors and **Henry W. Foulds** as president. Mr. Robertson has been president of the company for the past 15 years while Mr. Foulds has been executive vice-president since 1935. Prior to that time, he has been a vice-president and director of Goulds Pumps, Inc. and a vice-president of Servel, Inc.

Ludwig E. Loos has been appointed manager of purchases of **The Vilter Manufacturing Company**. Mr. Loos was formerly assistant manager of purchases for the company. He is a graduate of Marquette University.

W. S. O'Connor has been appointed New York District Sales Manager of the **United States Gauge Company**, Sellersville, Pa. The office is located in the Woolworth Building, 233 Broadway.

(Continued on page 116)

Engineered for CONTROLLED TEMPERATURES

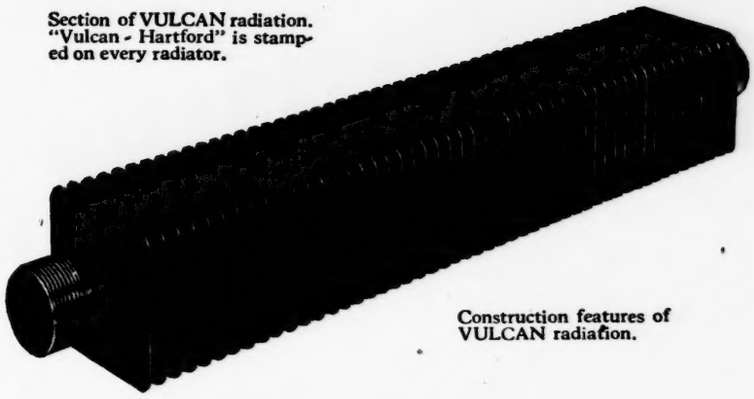
VULCAN continuous line radiation has set new standards in heat distribution, simplified installation, compressed greater heating surface into compact light weight units . . . one length of VULCAN being equal in heat output to eight 1½" pipes of the same length. Most of the heat is given off by convection, the air circulating gently but adequately throughout the heated space. Temperature varies little vertically . . . is uniform horizontally, drafts are eliminated.

CONSTRUCTED TO LAST

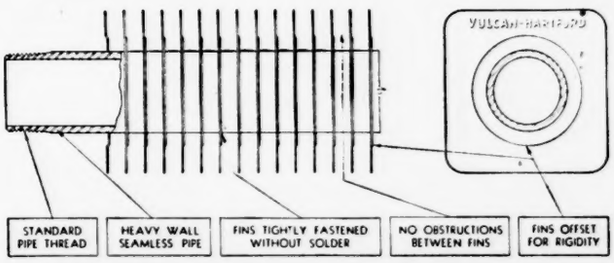
VULCAN uses heavy wall seamless steel pipe on which steel fins are permanently fastened by a special process which requires no solder. Fins are offset for greater rigidity. Sections come cut to length, ends threaded or chamfered. Few fittings are needed. VULCAN radiation will give many years of constant service with no maintenance.

Catalog on request.
Representatives in principal cities.

Section of VULCAN radiation. "Vulcan - Hartford" is stamped on every radiator.

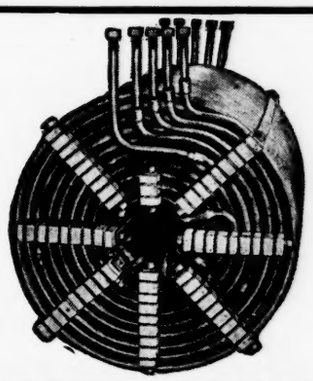


Construction features of VULCAN radiation.



THE VULCAN RADIATOR CO. 26 FRANCIS AVENUE 6, HARTFORD, CONN.
Radiator Manufacturers For Almost Two Decades

INTO THIS COIL WE BENT



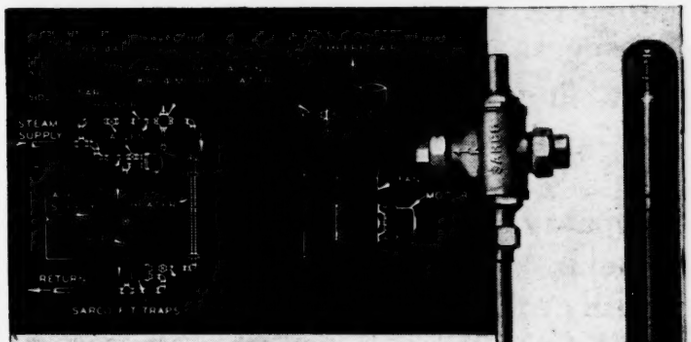
half a mile of COPPER TUBING

Here's a job typical of Swan's skill in precision pipe and tube bending. A certain naval condenser unit takes a lot of copper tubing—two tons of it! *Half a mile of it!* To be bent into a coil no bigger than a small clothes closet. Thermal requirements for maximum efficiency of the unit make necessary the placement of the coil surfaces with great precision in all three dimensions.

Swan Engineering did it!
And in quantity!
And on time!

Use our advisory engineering service in connection with your bending problems. Swan Engineering will quote promptly on bending jobs large or small, simple or complicated, in any of the usual metals or alloys including stainless steel and aluminum. *Send your bending to Swan!*

SWAN ENGINEERING COMPANY, Inc.
747 Frelinghuysen Ave. Newark 5, N. J.



SIMPLE TEMPERATURE CONTROL *for* AIR-HEATING OR COOLING

The Sarco KR-14 temperature regulator is a self-operated, liquid expansion type control, packless and easy to install. Used for air conditioning, refrigeration, dryers, ovens, ducts and all types of industrial process work. Temperatures 0° to 400° F., ½ to 8". Ask for Catalog No. 600.

KR-14

SARCO SAVES STEAM
SARCO COMPANY, INC.
475 Fifth Avenue, New York 17, N. Y.
SARCO CANADA LTD. 85 Richmond St. W. TORONTO, ONT.
172

Old King Cole was a merry old soul because he "knew his musicians" when he called for his fiddlers three. The reliable plumber and contractor can also become a "merry old soul" . . . and a thrifty one . . . by calling for the highest grade fittings from only responsible jobbers.

"K" fittings are precision cast and precision machined. Inspection controls "eagle eye" them step by step, from cupola to stock bins. That is why they make up fast, pull tight and reduce costly callbacks to a minimum. Ask for "K" fittings.

COMPLETE LINE. CATALOG ON REQUEST.

Standard and extra heavy cast iron screwed fittings. • Standard flanged fittings. • Standard and extra heavy companion flanges. • Drainage fittings.

KUHNS BROS. CO.
DAYTON 7, OHIO.

"K" fittings carried in stock at Malleable Iron Fittings Co., Branford Conn.; M.I.F. stocks at Kuhns Bros. Co., Dayton, Ohio.

(Continued from page 114)

Milton Way and **Carl Wolff** have formed **Ray Oil Burner Sales Inc.**, to act as exclusive factory distributors in Greater New York for the Ray Oil Burner Co. Messrs. Way and Wolff have been Ray's eastern marine distributors for several years under the firm name Way-Wolff Associates. They have organized the new company to handle the complete line of Ray industrial, commercial, marine and domestic oil burners and oil burning equipment.

Sterling Smith, Manager, **Refrigeration Division** of **Mills Industries, Inc.**, Chicago, has been selected as one of the 20 members of the General Refrigeration and Air Conditioning Manufacturers Industry Advisory Committee which meets in Washington the second Wednesday of each month and discusses problems of production, material, manpower, limitation orders, reconversion, and makes recommendations.

Sterling Smith

Mr. Smith has been in the refrigeration field for many years and was formerly Chief of Refrigeration and Air Conditioning Section of the WPB at Washington. He was also previously associated with the Nash-Kelvinator Corporation in New York.

Carrier Corporation's International Division announces that after January 22 the Division will be located at 122 East 42nd St., New York.

C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., has sold its assets, including goodwill, name and patents, to **Portable Products Corp.**, Pittsburgh, Pa. The business will be operated as a separate division of Portable Products. Among the interests of the latter are manufacturing plants located in Newburgh, N. Y., Philadelphia, Pa., and Pittsburgh, Pa.

Elmer I. Boardman has been named manager of heater and boiler sales of **Spencer Heater Division, The Aviation Corporation**, Williamsport, Pa. Mr. Boardman has had 25 years sales and executive experience in the heating field with American Radiator, National Radiator, Richardson & Boynton, Armstrong Furnace, and Lennox Furnace.

Elmer I. Boardman

Cleaver-Brooks Co., Milwaukee, Wis., has appointed **Frederick W. Hainer** as vice-president of the company, effective January 15.

Northern Equipment Company, Erie, Pa., has appointed **W. L. Hunter** as chief engineer. Mr. Hunter will supervise engineering, design and research. Associated with the company for 18 years, he has had wide experience in the development and problems of feed water control, desuperheating, and pressure reduction and is well known as an application consultant. Mr. Hunter graduated from the University of Tennessee in 1919 with the degree of mechanical engineer. The post of assistant chief engineer will be taken by H. A. Schlieder, associated with the company for eight years. He graduated from Rensselaer Polytechnic Institute in 1932 as an electrical engineer. H. H. Weining has been appointed director of research. Since his graduation from The Pennsylvania State College in 1926 as mechanical engineer, he has been in the employ of the company.

Paul B. Sagar

Paul B. Sagar has been appointed Eastern field engineer for **General Controls Co.**, Glendale, Calif. Working out of the Cleveland factory branch, 3224 Euclid Avenue, Mr. Sagar will devote the major part of his time collaborating with Eastern appliance manufacturers in working out problems of application and assisting them in test procedures at the AGA Laboratory. He has a background of test engineering in the Cleveland AGA laboratory. Mr. Sagar is a graduate mechanical engineer, Oregon State University, and served for five years as control engineer with iron Fireman previous to his present connection.

Air Reduction has made the following appointments effective January 1: **H. F. Henriques,** formerly sales manager of the North Central Division, is appointed general sales manager; **J. J. Lincoln,** formerly sales manager of the South Central Division, is appointed director of sales services; **C. M. Bloodgood,** who has been serving as sales manager of the Pacific Coast Division, is apppointed assistant to the vice-president in charge of sales; all will have offices at 60 E. 42nd St., New York 17, N. Y. **H. P. Etter,** heretofore manager of the Los Angeles District, is appointed sales manager of the Pacific Coast Division with headquarters in the Mills Tower Building, San Francisco.

R. E. Fritsch

R. E. Fritsch, vice-president of **Tube Turns,** Louisville, Ky., since 1929, has been elected president, succeeding Walter H. Girdler Sr., who died January 7. He joined Mr. Girdler when Tube Turns was originally organized and he has had a major part in the firm's rapid growth.

Mr. Fritsch continues as vice-president and a member of the board of directors of The Girdler Corporation, of which Tube Turns is an affiliate.

Earl L. Wiseman, manager, Ventilator Division of **The Swartwout Company,** Cleveland, has been named vice-president of the company. Mr. Wiseman was made manager of the division in 1943 and has been sales manager for eight years. The Swartwout Company manufactures industrial and commercial roof ventilators and steam power plant specialties.

Frank P. Rhame, director, vice-president, and assistant general manager of **The Lunkenheimer Company,** valve manufacturers, has been made general manager, succeeding Charles A. Brown, who retired December 31. Mr. Rhame has been associated with Lunkenheimer for over 25 years. **Homer E. Lunken,** a director, succeeds him as assistant general manager. **Carra L. Lane** has been named works manager, succeeding George A. Seyler, who announced his retirement as vice-president in charge of manufacturing in September, effective December 31. **Fred H. Hehemann,** assistant chief engineer, becomes chief engineer, succeeding Jerome J. Aull, who retired December 31 after nearly 50 years of service with the company. Harry A. Burdorf remains as a director and vice-president in charge of sales. Eshelby F. Lunken remains as a director and president of the company; Chester C. Isekeit as a director and treasurer; and Charles W. Burrage as secretary.

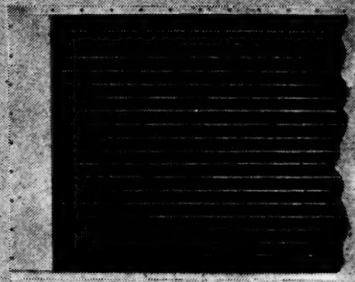
Equipment Supply Co., 1619 University Ave., St. Paul 4, Minn., has been appointed Twin City distributor for Link-Belt coal stokers, it is announced by **Link-Belt Co.,** Stoker Division, Chicago.

(Concluded on page 118)

McCORD
HEATING AND AIR CONDITIONING PRODUCTS

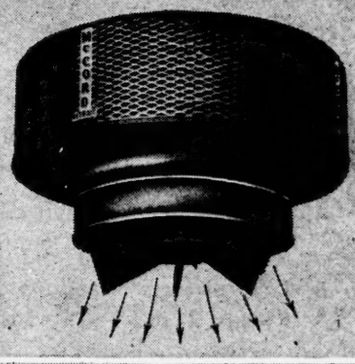
BLAST HEATING COILS
AIR CONDITIONING COILS
ALL TYPES

McCord spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded.



VERTICAL TYPE
UNIT HEATERS

A tried and proven heating unit, modern in design. McCord spiral fin tube construction creates air turbulence without undue restriction, thus increasing heat transfer capacity. Guaranteed for 150 lbs. saturated steam pressure. Nine models.



HORIZONTAL TYPE
UNIT HEATERS

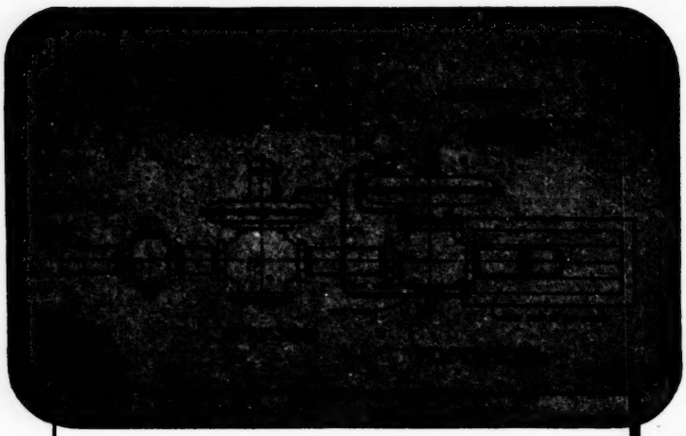
Proven, rugged, modern design. Quiet, guaranteed for use on #150 p.s.i. steam pressure. Heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Ten models.

YOU CAN DEPEND ON McCORD AIR CONDITIONING PRODUCTS

McCord RADIATOR & MFG. CO.
DETROIT II, MICH.

Insist on these 5 FEATURES

For efficiency, safety and economy, specify the ONE valve that answers *all* your requirements for industrial and commercial burners and furnaces.



GENERAL CONTROLS

Type B-55

Slow Opening Gas Valve

Here, in one sturdily-constructed easily-installed valve, you get everyone of these necessary features.

1. Adjustable opening time—5 to 60 seconds.
2. Widest operating pressure range—handles up to 5 lbs.
3. Widest range of sizes—available from ¾" to 6" i.p.s. for manufactured, natural or L. P. gases.
4. Ample power for louvre control. Damper arm easily rotated to any desired position.
5. Low current consumption. In sizes up to 1½" i.p.s. 8 watts; 2" to 6"—14 watts.

The advanced design of this valve has made it the choice of industry. Simplicity of design makes this unit foolproof and trouble-free. Fast closing time is fixed, regardless of opening adjustment. The 3-way pilot valve is operated by the quiet General A.C. Solenoid. B-55's are fail-safe in the event of diaphragm rupture, current failure or binding damper mechanism.

For further information, contact your nearest General Controls factory branch or distributor, or write for Catalog 52-B.

GC

(Concluded from page 117)

C. F. Patterson has joined the field engineering staff of the **Eutectic Welding Alloys Company.** A native of Canada, Mr. Patterson will service customers in Michigan. He was with the Murray Corporation for 18 years. **John A. Owen,** a veteran welder and machine shop operator for 28 years, will serve as field engineer for the Eutectic Co., for the state of North Carolina.

A laboratory for testing domestic heating fuels will be constructed by the **Socony-Vacuum Oil Company, Inc.,** at 412 Greenpoint Avenue, Brooklyn. The laboratory is expected to be in operation early in the Spring. The laboratory will be a one-story, three-room building and will have the necessary facilities for studying the practical performance of fuel oils in commercial burners.

Effective January 1, **Crane Co.** has made several important changes in the management of its branches, due to retirement of two of its branch managers of long standing. In Los Angeles, D. D. Updegraff, manager since 1936, has resigned on advice of his physician to take a well-earned and needed rest. Mr. Updegraff is succeeded by **R. E. Penny,** manager of Jacksonville branch since 1941. Mr. Penny was formerly manager at San Bernardino (1935) and Phoenix (1938) before going to Jacksonville. **L. R. Bauer,** who served as manager at Brooklyn and New Haven, goes to Jacksonville to succeed Mr. Penny. **J. J. Murray,** once manager at Worcester, and more recently a planning department analyst at the Chicago works, is appointed manager at New Haven. In Memphis, Tenn., F. A. Duncan, manager since 1922, retires after 43 years of loyal service. He joined the Crane organization October 1, 1901 at St. Louis, and moved to Memphis in 1905. He is succeeded by **O. F. Woodyard,** former manager at Little Rock, Ark., who, in turn is followed by **A. C. Gribble,** who was a salesman at the Houston branch.

COMING EVENTS

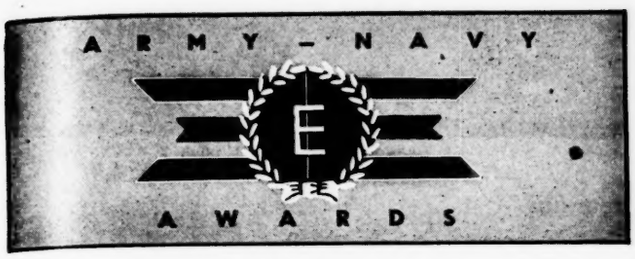
APRIL 16-18—Spring meeting of the American Society of Mechanical Engineers, Boston, Mass. Secretary, C. E. Davies, 29 W. 39th St., New York 18, N. Y.

JUNE 10-13—Summer convention of the American Society of Refrigerating Engineers to be held at the Hotel Schroeder, Milwaukee, Wis. Secretary David L. Fiske, 50 W. 40th St., New York 18, N. Y.

JUNE 17-21—Semi-annual meeting of the American Society of Mechanical Engineers, Chicago, Ill. Secretary, C. E. Davies, 29 W. 39th St., New York 18, N. Y.

SEPTEMBER 17—Third Wartime Conference and 74th Annual meeting of American Public Health Association to be held at the Hotel Stevens, Chicago, Ill. Executive secretary, Reginald M. Atwater, M.D., American Public Health Association, 1790 Broadway, New York 19, N. Y.

OCTOBER 1-3—Fall meeting of the American Society of Mechanical Engineers, Cincinnati, Ohio. Secretary, C. E. Davies, 29 W. 39th St., New York 18, N. Y.



Farr Company, Los Angeles, Calif.

Bell & Gossett Company, Morton Grove, Ill.

Kieley and Mueller, Inc., North Bergen, N. J.
(Second star for "M" pennant)

Farris Engineering Co., Ridgefield, N. J.
("M" award)

The Kennedy Valve Mfg. Co., Elmira, N. Y.
(Second star for "M" pennant)

INDUSTRIAL DEGREE DAYS

December, 1944

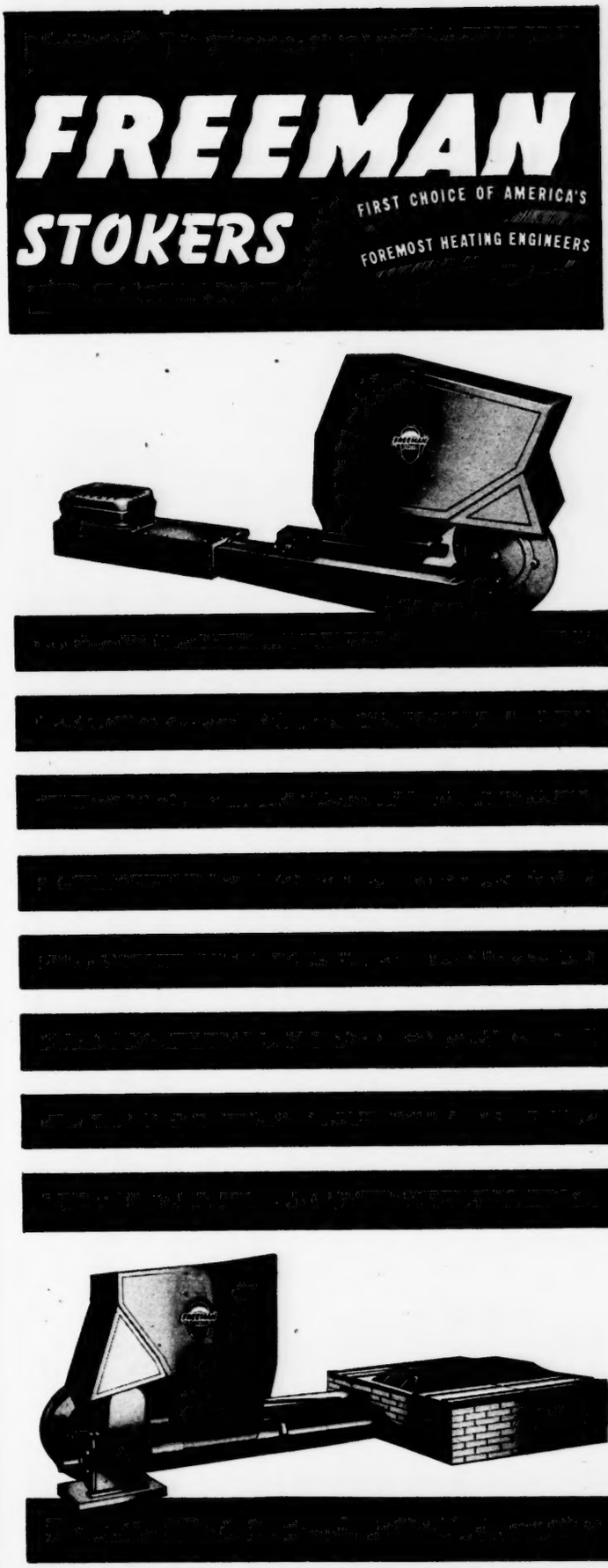
City	55F Base	45F Base
Baltimore, Md.	626	329
Buffalo, N. Y.	918	608
Chicago, Ill.	1026	716
Cleveland, Ohio	857	547
Detroit, Mich.	940	630
Indianapolis, Ind.	868	558
New York, N. Y.	700	403
Philadelphia, Pa.	663	356
Pittsburgh, Pa.	782	472
St. Louis, Mo.	796	486

Canadian Degree-Days for December, 1944*

City	December 1944	December Normal	Cumulative, Sept. 1 to Dec. 31 1944	Cumulative, Sept. 1 to Dec. 31 Normal
Calgary, Alta.	1302	1426	3129	3702
Charlottetown, P. E. I.	1256	1246	2716	2865
Crescent Valley, B. C.	1215	1240	2878	3279
Edmonton, Alta.	1516	1609	3710	3982
Fort William, Ont.	1600	1596	3539	3815
Grande Prairie, Alta.	1593	1649	3999	4159
Halifax, N. S.	1070	1147	2355	2633
London, Ont.	1376	1200	2865	2677
Medicine Hat, Alta.	1466	1417	3395	3389
Moncton, N. B.	1392	1373	3034	3186
Montreal, P. Q.	1596	1407	3231	3096
North Bay, Ont.	1578	1528	3559	3503
Ottawa, Ont.	1612	1494	3322	3277
Penticton, B. C.	1073	1073	2474	2626
Porquis Junction, Ont.	1730	1786	4053	4248
Prince George, B. C.	1590	1504	3666	3757
Quebec City, P. Q.	1550	1534	3235	3511
Regina, Sask.	1680	1779	3856	4336
St. John, N. B.	1271	1271	2809	2969
Saskatoon, Sask.	1668	1767	3854	4249
Toronto, Ont.	1210	1155	2591	2651
Vancouver, B. C.	868	818	2131	2168
Victoria, B. C.	738	738	1778	1910
Windsor, Ont.	1277	1172	2400	2446
Winnipeg, Man.	1705	1829	3775	4205

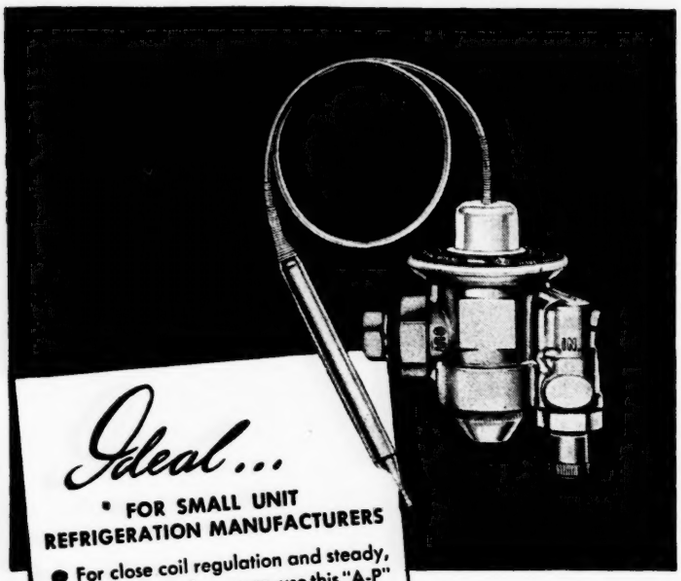
*These data are supplied through the courtesy of the Meteorological Division, Air Services Branch, Department of Transport, Canada, with the cooperation of N. W. Etter, Heating Engineer, Enamel & Heating Products Limited, Sackville, N. B.

The Department reports that some of the figures for November, as published in last month's issue, were slightly in error. Corrected figures are: Crescent Valley, B. C., 888; Fort William, Ont., 951; Montreal, P. Q., 879; Penticton, B. C., 792; Porquis Junction, Ont., 1146 and St. John, N. B., 792.



Dependability doesn't happen...

IT'S *BUILT INTO* EVERY A-P VALVE



Ideal...

• FOR SMALL UNIT REFRIGERATION MANUFACTURERS

● For close coil regulation and steady, dependable performance, use this "A-P" Model 206 Thermostatic Expansion Valve. Factory-set at your desired superheat setting, no field adjustments are required, and the valve remains tamper-proof. Built under rigid factory inspection — with all parts microscopically examined and thoroughly tested during and after fabrication. Install Model 206 with full confidence in any application where the superheat setting has been predetermined.

MODEL 206
(FIXED SUPERHEAT) THERMOSTATIC EXPANSION VALVE

Wherever a non-adjustable expansion valve is required, or preferred, the A-P Model 206 is best. Absolutely reliable and dependable, it maintains a constant superheat over a wide range of evaporator temperatures — a real advantage in this type of valve. Its maximum capacity — 0.61 tons Freon; 1.32 tons Methyl or Sulphur.

NOTE THESE FEATURES...

★ Liquid cross-charged for maximum efficiency
★ Three orifice sizes
★ Built-in Strainer 1.23 sq. in.
★ Small size for hard-to-get-at applications
★ Factory-set superheat 10; 5 to 15 degree available range
★ Free acting diaphragm

AUTOMATIC PRODUCTS COMPANY
2462 North Thirty-Second Street • Milwaukee 10, Wisconsin
Export Department — 13 East 40th Street, New York 16, New York

DEPENDABLE REFRIGERANT VALVES
Stocked and Sold by Progressive Refrigeration Jobbers Everywhere — Recommended and Installed by Leading Refrigeration Service Engineers.

NEW CATALOGS

Bearings

Revised bulletin 105, entitled "High Capacity Ball Reciprocating Bearings," which covers a new list of recommended sizes. The bulletin gives operating capacities per row of balls for 100 rpm, based on an average life of 3,000 hours, and other pertinent engineering data. —*Torrington Co., Bantam Bearings Div., So. Bend 21, Ind.*

Corrosion Resisting Alloys

An 80-page, 6 x 9 in. booklet, which is more of a textbook than a catalog, relating to the company's Duronze high strength corrosion resisting copper-base alloys. Particularly recommended where resistance, corrosion resistance and high tension strength are desirable, such as in certain types of nuts and bolts, machine parts, gears and shafts, valves and valve stems, pumps, similar parts, for tubing heat expansion, and so on. The material is available in five different types designated as Duronze I, II, III, IV and V, each having a different property. The book contains detailed specifications, characteristics, properties, and other data. Includes a chapter of information on machining Duronze.—*Bridgeport Brass Company, Bridgeport 2, Conn.*

Boilers

A six-page folder covering the International-LaMont steam generators, type LFS. Bulletin states that the prefabrication and shop tested sub-assemblies reduce boiler erection time and lists distinctive features of LFS boilers. Also illustrates how increased capacities may be obtained from existing boiler installations.—*The International Boiler Works Co., East Stroudsburg, Pa.*

V-Belts

Information to help one make correct drive selections contained in a 12-page illustrated booklet, B6051E. Stock sizes, dimensions, construction details are given for all Texrope drives.—*Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.*

Postwar Products

An 84-page, standard size bulletin PB290 permits selection of heating, cooling, air handling and air conditioning equipment now for civilian construction projects that will get underway once the war is over. Contains information concerning company's products that will be available when restrictions on civilian construction have been removed. Products are carefully illustrated, with sufficient data on capacities and roughing-in dimensions to make possible satisfactory selection of equipment illustrated. Twenty-four pages are devoted to large size illustrations of all company's products. New products are shown and include such items as a new induced draft cooling tower, revised refrigeration line, new convector models, improved hot water products. Catalog is divided into twelve major sections which in addition to picture pages, also include from four to six pages of data information. Capacity tables have been condensed. Roughing-in dimensions have been streamlined. Selection data have been boiled down. It is punched to fit all standard binders and looseleaf covers. —*The Trane Co., La Crosse, Wis.*

Heat Exchangers

A 10-page, 5¼ x 7½ in. booklet entitled "Care and Handling of Heat Exchangers" and containing highly condensed and practical pointers on installation, operation, maintenance, cleaning, and corrosion.—*The Whitlock Manufacturing Co., Hartford 1, Conn.*

Heating Coils

A new and broader line of copper blast heaters and booster units has been introduced by the Modine Manufacturing Co. The line is described in catalog 345 containing 20 illustrated pages.—*Modine Manufacturing Co., Racine, Wis.*

Oil Burner

A 4-page standard size Bulletin No. 802, devoted to the company's type M oil burners. Describes and illustrates the mechanical and operating features of the burner for natural or forced draft operation and for use with mechanical, wide range mechanical, or steam atomizers. —*Peabody Engineering Corp., 580 Fifth Avenue, New York 19, N. Y.*

Welding Training

Designed to set forth in a clear and understandable manner how welding processes differ, how electronic control for resistance welding works, and how this method of control extensively adapts the resistance welding process to industry, a new seven-part training course by slide sound films, lesson books, quiz book, and an instructor's manual has been prepared by Westinghouse. Although produced primarily for Westinghouse employees, the material has been made available to others at reproduction costs because of many requests from engineering groups and individuals interested in resistance welding control. It is recommended that 8 to 10 hours should be allowed for the full seven-part course, two hours for each of the four lessons. Slide films and records for the seven lessons give clear, visual explanations of the basic theory and applications. (For use with 35 mm sound slide film equipment.) Seven lessons in handy pocket size, reproducing the subject matter of each lesson, are provided each member of the class. These afford a convenient means of review and supplemental study. One quiz book is supplied each member of the class for final review of subjects covered. An instructor's manual giving suggested class-room procedure is provided with complete course. Informative booklets on resistance welding in industry supplement course material. For a class of 20 a complete set of material costs $50. Orders for the resistance welding control training course should be sent to *C. R. Riker, supervisor, extension training, Westinghouse Electric & Mfg. Co., 306 Fourth Avenue, Room 1712, Pittsburgh, Pa.*

Motors

A four-page standard size loose-leaf punched bulletin entitled Redmond Micromotors and devoted to the company's type L shaded-pole motor. Gives dimensional, instruction, performance and design data for these motors which cover a variety of sizes up to 1/40 hp.—*A. G. Redmond Co., Owosso, Mich.*

Wartime Activities

In "Ilg Fights its Second War," an 8-page illustrated booklet, is presented a collection of photographs to show how Ilg equipment and apparatus are being used by the Army and the Navy.—*Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago, Ill.*

(Concluded on page 122)

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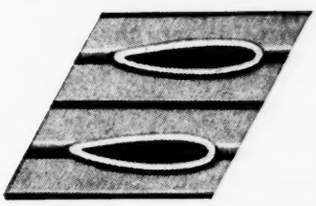

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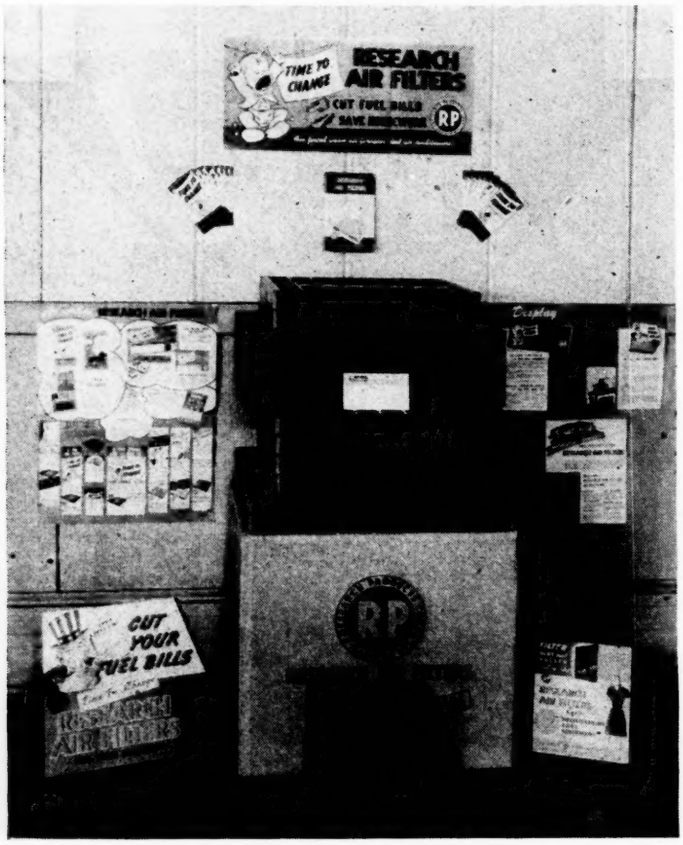

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(Concluded from page 121)

Electronics

Standard sized publication GEA-4309, entitled "Fundamentals of Industrial Electronics" and containing a series of eight articles which appeared in *Steel*. 40 pages.—*General Electric Company, Schenectady, N. Y.*

Frame Construction

A 20-page catalog, general Bulletin No. 1, devoted to the company's Unistrut, described as a "man-sized building set." Unistrut consists of 1⅝ x 1⅝ inch square steel sections partially open on one side, and containing a patented nut. The member can be cut to desired lengths on the job to form a skeleton. Applicable to all jobs of a construction nature covering a wide variety of pipe hangers, cabinet frames, supports, racks, welding positioners and even drafting-room tables. — *Unistrut Corp., Wayne, Mich.*

Welded Tubing

A 34-page illustrated booklet to describe how electric welded tubing is made and to show how it is being applied to war products and by private industry. It contains specifications for various tubing applications. —*Formed Steel Tube Institute, Keith Bldg., Cleveland 5, Ohio.*

ATMOSPHERIC POLLUTION

(Concluded from page 74)

equipment having a capacity of 600 tons of SO_2 per day has been installed. All of these and other signs point to a future in which SO_2, the principal gaseous atmospheric contaminant, may eventually be brought under control in our cities and towns. Until this happens the ventilating engineer will have to continue to take air from an atmosphere sufficiently acid as to require corrosion protection of air washing and similar air handling equipment.

Measurement Methods

Three types of chemical measurement methods for gaseous air contaminants are available—snap or grab samples, aspirated samples and exposure samples. In the first, a bottle or burette full of air is taken and analyzed. In the second, a pump and air flow meter is used to bubble a sample through an absorbent solution for a period of time measured in minutes or hours. In the third, a reactant chemical is exposed to the atmosphere for a period of weeks or months and is then returned to the laboratory for analysis. Electrical or physical methods of measurement depending on ultra-violet absorption, thermal conductivity, catalytic combustion cells, interferometers, or similar gaseous phase means may be considered as equivalent to snap sampling methods; those employing liquid phase electrical conductivity cells may usually be used for either snap or aspirated samples. For details of the various analytic methods employed for different contaminants reference should be had to a textbook on air or gas analysis, or on industrial hygiene.

THE WELDING OF PROCESS PIPE

(Continued from page 62)

of sorts may be effected by various means. These in general however are of low tensile strength and ductility and hence of no practical value.

The method of joining cast iron to steel, box 1-6, is governed by service conditions. Where the presence of a dissimilar metal is acceptable, then braze welding is to be preferred since it provides a strong ductile joint and avoids hard spots adjacent to the weld in the cast iron. These characteristics may not so readily be produced by arc welding techniques. Silver alloy brazing may also be employed, although infrequently difficulty may be encountered in tinning the silver alloy onto dirty cast iron. Metal arc welding using the aluminum bronze electrode may offer a solution in some instances. This technique is usable in the flat position only.

Braze welding of cast iron to steel may be accomplished with any of the brass rods (Analyses I, III or IV) although the manganese and low fuming types will prove the most satisfactory. A flux is essential to control the deposition of the brass and to assist in tinning the brass onto the cast iron. Where particularly dirty cast iron is encountered, a separate bonding flux is recommended for application to the cast iron to facilitate the tinning action. Since cast iron has low tensile strength and virtually no ductility it is important when applying heat to study the part so that undue strains and cracking may be avoided. Preheating or supplementary heating will usually avoid cracking.

Brazing of cast iron and steel with the silver-copper-cadmium-zinc alloy requires the use of the lap type joint. A silver brazing flux is also essential. Since this operation takes place at a lower temperture, the necessity for special precautions against cracking is not as urgent as in braze welding. Nevertheless it would be wise to apply some supplementary heat when brazing locally on closed members such as flanges.

The connecting of steel and cast iron elements by means of the aluminum bronze electrode requires that the steel be ground to a bright finish along the line of weld. The cast iron must be carefully cleaned of scale, grease and graphite. It is also desirable to preheat the cast iron to about 250-300F and to use low currents. The arc should be maintained in the pool[4] of molten bronze to avoid melting either the steel or cast iron and to prevent creation of hard spots.

[4]Welding Handbook—American Welding Society, 1942, pp 882-883.

(To be continued)

The next section will cover copper and copper base alloys.

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